ACTA RADIOLOGICA

Redactores

A. Akerlund, Stockholm
Chr. I. Baastrup, København
G. Claessen, Reykjavik
T. Dale, Oslo
G. Forssell, Stockholm
J. Frimann-Dahl, Oslo
R. Gilbert, Genève
L. G. Heilbron, Amsterdam
J. W. F. Heukensfeldt Jansen, Amsterdam
G. Jansson, Helsingfors
S. Mustakallio, Helsingfors
P. Flemming Møller, København
H. R. Schinz, Zürich

Editor

Gösta Forssell, Stockholm

Collaborant

In Dania: Jens Nielsen, København; C. Krebs, Aarhus; S. Lomholt, København. *In Fennia:* Y. Lassila, Helsingfors; K. Setälä, Helsingfors; Carl Wegelius, Helsingfors. *In Helvetia:* M. Lüdin, Basel; A. Zuppinger, Bern; A. Rosselet, Lausanne. *In Hollandia:* G. F. Gaarenstroom, Amsterdam; S. Keijser, Groningen; H. W. Stenvers, Utrecht. *In Norvegia:* S. Bakke, Bergen; R. Bull Engelstad, Oslo; H. Reitan, Oslo. *In Suecia:* E. Berven, Stockholm; L. Edling, Lund; H. Laurell, Uppsala.

Vol. XXIX. January—June 1948

Stockholm: P. A. Norstedt & Söner

STOCKHOLM 1948
KUNGL. BOKTRYCKERIET. P. A. NORSTEDT & SÖNER
480088

ACTA RADIOLOGICA, published by *the Societies for Medical Radiology* in *Denmark, Finland, Holland, Norway, Sweden* and *Switzerland,* contain articles pertaining to *roentgenology, radium therapy, light therapy,* and *electrotherapy.* These articles are published in English, French or German according to the decision of the author. From 1948 on, *two* volumes appear annually. Each volume comprises about 500 pages, distributed in six occasional numbers. *Subscriptions* may be forwarded to Acta Radiologica, Stockholm 2, Sweden. **Subscription** rate per Vol.: *35 Sw. crowns, postage 3 Sw. crowns additional for non-Scandinavian countries, payable in advance. Single copies 7 Sw. crowns plus postage. The subscription will be considered renewed if it has not been cancelled at the latest a month after receipt of the invoice.*

ACTA RADIOLOGICA, herausgegeben von den *Gesellschaften für medizinische Radiologie* in *Dänemark, Finnland, Holland, Norwegen, Schweden* und in der *Schweiz,* enthalten Arbeiten auf den Gebieten der *Röntgenologie, Radiumtherapie, Lichttherapie* und *Elektrotherapie.* Die Beiträge werden je nach eigener Wahl des Verfassers, in deutscher, englischer oder französischer Sprache veröffentlicht. Ab 1948 erscheinen *zwei* Bände jährlich. Jeder Band enthält za 500 Seiten, in sechs zwangfreien Heften erscheinend. *Abonnement* bei Acta Radiologica, Stockholm 2, Schweden. **Abonnementspreis** je Band: *35 schw. Kronen, zuzügl. Postgebühren, 3 schw. Kronen für nicht-Skandinavische Länder, im voraus zu bezahlen. Einzelne Hefte 7 schw. Kronen zuzügl. Postgebühren. Die Zeitschrift wird den Beziehern bis zur Abbestellung geliefert; diese muss spätestens einen Monat nach Empfang der Rechnung bei der Redaktion eingehen.*

ACTA RADIOLOGICA, revue publiée par les *sociétés de radiologie médicale du Danemark, de Finlande, de Hollande, de Norvège, de Suède* et *de Suisse,* contient des articles concernant la *radiologie,* la *radiumthérapie, l'héliothérapie* et *l'électricité médicale.* Les études sont publiées en français, en anglais ou en allemand au choix de l'auteur. A partir de 1948, *deux* volumes sont publiés par année. Chaque volume renferme environ 500 pages divisées en six fascicules. *On s'abonne* au bureau des Acta Radiologica, Stockholm 2, Suède. **Prix de l'abonnement** par Volume: *35 couronnes suéd., port, 3 cour. suéd., en sus pour les pays non-Scandinaves, payable d'avance. Prix par fascicule 7 couronnes suéd., port en sus. L'abonnement se renouvelle automatiquement s'il n'est pas résilié un mois aprés réception de la facture, au plus tard.*

† — 480088

22648

Supplements to the

ACTA RADIOLOGICA

I. Åke Åkerlund: *Röntgenologische Studien über den Bulbus Duodeni.* 1921. (Out of print.)

II. Gösta Forssell: *On the Permanency of Radiological Healing in Malignant Tumours.* 1928. Price bound Sw. cr. 10: —; unbound Sw. cr. 8: —.

III. An Account of the Second International Congress of Radiology, Stockholm, 1928. Price Sw. cr. 15: —.

IV. Teaching and Training in Medical Radiology. Papers delivered at the Second International Congress of Radiology. 1930. Price Sw. cr. 20: —.

V. Catalogue des Portraits des Membres du Deuxième Congrès International de Radiologie à Stockholm. 25—27 Juillet 1928. 2ème Edition, complétée. Price Sw. cr. 5: —.

VI. Gunnlaugur Claessen: *The Roentgen Diagnosis of Echinococcus Tumors.* 1928. Price Sw. cr. 15: —.

VII. Martin Odin & Gösta Runström: *Iodized Oils as an Aid to the Diagnosis of Lesions of the Spinal Cord and a Contribution to the Knowledge of Adhesive Circumscribed Meningitis.* 1928. Price Sw. cr. 15: —.

VIII. Carl Krebs: *The Effect of Roentgen Irradiation on the Interrelation between Malignant Tumors and their Hosts.* 1929. Price Sw. cr. 8: —.

IX. Jens Juul: *Experimental Studies on Roentgen Treatment of Malignant Tumors.* 1929. Price Sw. cr. 8: —.

X. Carl Krebs, H. C. Rask-Nielsen & Aage Wagner: *The Origin of Lymphosarcomatosis and its Relation to other Forms of Leucosis in White Mice.* 1930. Price Sw. cr. 8:—.

XI. Elis Berven: *Malignant Tumors of the Tonsil.* 1931. Price Sw. cr. 22: —.

XII. Erik Lysholm: *Apparatus and Technique for Roentgen Examination of the Skull.* 1931. Price Sw. cr. 25: —.

XIII. S. Bakke: *Röntgenologische Beobachtungen über die Bewegungen der Wirbelsäule.* 1931. Price Sw. cr. 10: —.

XIV. R. Sievert: *Eine Methode zur Messung von Röntgen-, Radium- und Ultrastrahlung nebst einigen Untersuchungen über die Anwendbarkeit derselben in der Physik und der Medizin.* 1932. Price Sw. cr. 20: —

XV. R. Thoræus: *A Study of the Ionization Method for Measuring the Intensity and Absorption of Roentgen Rays and of the Efficiency of Different Filters Used in Therapy.* 1932. Price Sw. cr. 10: —.

XVI. T. Dale: *Der Wert der Röntgenuntersuchung in der Lungendiagnostik.* 1932. Price Sw. cr. 10: —.

XVII. G. Runström: *A Roentgenological Study of Acute and Chronic Otitis Media.* 1933. Price Sw. cr. 20: —.

XVIII. R. Schatzki: *Reliefstudien an der normalen und krankhaft veränderten Speiseröhre.* 1933. Price Sw. cr. 20: —, bound 23: —.

XIX. R. Bull Engelstad: *Über die Wirkungen der Röntgenstrahlen auf die Lungen.* 1934. Price Sw. cr. 10: —.

XX. I. Hermodsson: *Röntgenologische Studien über die traumatischen und habituellen Schultergelenkverrenkungen nach vorn und nach unten.* 1934. (Out of print.)

XXI. B. Faber: *Röntgenbiologische Untersuchungen mit Gewebekulturen als Indikator* 1935. Price Sw. cr. 8: —.

XXII. W. Magnusson: *Skin Cancer.* 1935. Price Sw. cr. 20: —.

XXIII. H. Ahlbom: *Mucous- and Salivary-gland Tumours.* 1935. Price Sw cr. 20: —.

XXIV. E. Lysholm: *Das Ventrikulogramm.* I. Teil. 1937. Price Sw. cr. 10: —.

XXV. E. Lysholm: *Das Ventrikulogramm.* II. Teil. 1937. Price Sw. cr. 15: —.

XXVI. E. Lysholm: *Das Ventrikulogramm.* III. Teil. 1935. Price Sw. cr. 12: —.

XXVII. H. Hellmer: *Röntgenologische Beobachtungen über die Ossifikation der Patella.* 1935. Price Sw. cr. 10: —.

XXVIII. F. Knutsson: *Urethrography.* 1935. Price Sw. cr. 12: —.

XXIX. O. Kaalund-Jørgensen: *Experimental Studies on a Transmissible Myelomatosis (Reticulosis) in Mice.* 1936. Price Sw. cr. 12: —.

XXX. K. Lindblom: *A Roentgenographic Study of the Vascular Channels of the Skull.* 1936. Price Sw. cr. 10 —.

XXXI. S. Grettve: *Morphologische und tierexperimentelle Studien über das Schleimhautrelief des Magen-Darmkanals.* 1936. Price Sw. cr. 10: —.

XXXII. H. Wulff: *Die Zuverlässigkeit der Röntgendiagnostik — besonders hinsichtlich des Wertes der Urographie — und die Prognose bei Nieren- und Harnleitersteinen.* 1936. Price Sw. cr. 15: —.

XXXIII. J. Frimann-Dahl und G. Waaler: *Röntgenologische und pathologisch-anatomische Studien über den tuberkulösen Primärkomplex.* 1936. Price Sw. cr. 9: —.

XXXIV. S. Ribbing: *Studien über hereditäre, multiple Epiphysenstörungen.* 1937. Price Sw. cr. 8: —.

XXXV. A. Renander: *Le traitement radiologique de l'actinomycose.* 1937. Price Sw. cr. 8: —.

XXXVI. G. Jönsson: *Malignant Tumors of the Skeletal Muscles, Fasciæ, Joint Capsules, Tendon Sheats and Serous Bursæ.* 1938. Price Sw. cr. 20: —.

XXXVII. B. Lilja: *Displacement of the Calcified Lineal Body in Roentgen Pictures as an Aid in Diagnosing Intracranial Tumors. An Anthropometrical Statistical Analysis.* 1939. Price Sw. cr. 10: —.

XXXVIII. King Gustaf V's Stockholm Jubilee Clinic. 1939. Price Sw. cr. 8: —

XXXIX. G. Fr. Petersen: *Röntgenologische Untersuchungen über Arteriosklerose.* 1941. Price Sw. cr. 8: —.

XL. T. Denstad: *Über die Bedeutung der Röntgenuntersuchung für die Kardiologie.* 1940. Price Sw. cr. 8: —.

XLI. A. Renander: *The Roentgen Density of the Cystine Calculus.* 1941. Price Sw. cr. 15: —.

XLII. S. Welin: *Beiträge zur Röntgendiagnostik der Otitis Media Acuta und ihrer Komplikationen im Schläfenbein.* 1941. Price Sw. cr. 20: —.

XLIII. S. R. Kjellberg: *Hystero-Salpingo-Pelvigraphie.* 1942. Price Sw. cr. 15: —.

XLIV. Carl Krebs, Oskar Thordarson and Johannes Harbo: *Experiments with Mammalian Sarcoma Extracts in Regard to Cell-free Transmission and Induced Tumor Immunity.* 1942. Price Sw. cr. 10: —.

XLV. J. Torgersen: *The Muscular Build and Movements of the Stomach and Duodenal Bulb.* 1942. Price Sw. cr. 15: —.

XLVI. Torbjörn Caspersson and Lars Santesson: *Studies on the Protein Metabolism of the Epithelial Tumours.* 1942. Price Sw. cr. 12: —.

XLVII. Olle Olsson: *Die Urographie bei der Nierentuberkulose.* 1943. Price Sw. cr. 15:—.

XLVIII. Bertil Ebenius: *Cancer of the Lip.* 1943. Price Sw. cr. 20:—.

XLIX. Arne G. Forssberg: *Studien über einige biologische Wirkungen der Röntgen- und γ-Strahlen, insbesondere am Phycomyces Blakesleeanus.* 1943. Price Sw. cr. 15:—

L. Eivind Stokkeland: *Radiotherapy in Actinomycosis.* 1943. Price Sw.cr. 8:—.

LI. Jens Munck Nordentoft: *The Value of the Barium Enema in the Diagnosis and Treatment of Intussusception in Children.* 1943. Price Sw. cr. 15: —.

LII. Torfinn Denstad: *The Radiosensitivity of the Bone Marrow.* 1943. Price Sw. cr. 15:—.

LIII. Ragnar Steinert: *Renal Tuberculosis and Roentgenologic Examination.* 1943. Price Sw. cr. 15:—.

LIV. Sven Hultberg: *Untersuchungen über die Röntgennahbestrahlung.* 1943. Price Sw. cr. 15:—

LV. Magnus Strandqvist: *Studien über die kumulative Wirkung der Röntgenstrahlen bei Fraktionierung.* 1944. Price Sw. cr. 25: —.

LVI. Arne Engeset: *Cerebral Angiography with Perabrodil (Carotis Angiography).* 1944. Price Sw. cr. 25: —.

LVII. Sture Rödén: *On Cancer of the Breast, with Special Reference to the Results of Different Methods of Treatment.* 1944. Price Sw. cr. 8: —.

LVIII. Nils P. G. Edling: *Urethrocystography in the Male with Special Regard to Micturition.* 1945. Price Sw. cr. 20: —.

LIX. Bengt Sylvén: *Ester Sulphuric Acids of High Molecular Weight and Mast Cells in Mesenchymal Tumors.* 1945. Price Sw. cr. 15: —.

LX. Sven Johnsson: *A Contribution to the Diagnostics of Nephromata.* 1946. Price Sw. cr. 15: —.

LXI. Bengt S. Holmgren: *Inkonstante Hypopharynxdivertikel. Eine röntgenologische Untersuchung.* 1946. Price Sw. cr. 15: —.

LXII. Hans-Gösta Skarby: *Beiträge zur Diagnostik der Paranephritiden mit besonderer Berücksichtigung des Röntgenverfahrens.* 1946. Price Sw.cr. 15: —.

LXIII. Arne Engström: *Quantitative Micro- and Histochemical Elementary Analysis by Roentgen Absorption Spectrography.* 1946. Price Sw. cr. 10: —.

LXIV. Axel Ingelman-Sundberg: *Rectal Injuries Following Radium Treatment of Cancer of the Cervix Uteri.* 1947. Price Sw. cr. 10: —.

LXV. Hans Hellmer: *Intussusception in Children. Diagnosis and Therapy with Barium Enema.* 1948. Price Sw. cr. 15: —.

LXVI. Ivan Hermodsson: *On the Roentgenologic Appearance of Osteo-Arthrosis Deformans in the Hip Joint.* 1947. Price Sw. cr. 10: —.

LXVII. Harry Mossberg: *Thrombocytopenia Following Local Radiotherapy.* 1947. Price Sw. cr. 15: —.

LXVIII. Folke Jacobsson: *Carcinoma of the Tongue.* 1948. Price Sw. cr. 20: —.

LXIX. Erik Lindgren: *A Pneumographic Study of the Temporal Horn with Special Reference to Tumours in the Temporal Region.* 1948. Price Sw. cr. 25: —.

The Supplements may be ordered through Acta Radiologica, Stockholm 2, Sweden, or through the booksellers.

Contents of Volume XXIX.

Erik Lysholm. In Memoriam	*Åke Åkerlund*	1
Two Synovial Fibrosarcomas (Jönsson)	*Folke Knutsson*	4
Early Pleural Effusion in Pulmonary Embolism and Pneumonia or Bronchopneumonia	*Gunnar Moberg*	7
Sur la pathologie et le diagnostic radiologique du cancer apical pulmonaire et des tumeurs malignes péri-apicales (Syndrome de Pancoast et Tobias)	*R. Mathey-Cornat* et *de Fleurian*	19
Hemosiderosis of the Lungs — Typical Roentgenological Findings	*Olle Elgenmark* and *Sven Roland Kjellberg*	32
Chronic Mastoiditis and its Roentgen Picture	*Marcus Diamant* and *Bengt Lilja*	37
On Changes of the Optic Canal in Cases of Intracranial Tumor	*Arne Engeset* and *Arne Torkildsen*	57
Stereo Screen Photography	*Tauno Mannila*	65
On Roentgenological Diagnosis of »Jejunitis Acuta Phlegmonosa»	*O. W. Husebye*	71
Technical Improvements in Cerebral Angiography	*Arne Engeset* and *Hans Kvadsheim*	83
On Pyelogenic Renal Cysts	*Harry Holm*	87
Subdural Hematoma Outlined with Air in Encephalogram	*Olle Olsson*	95
Screen Photography Equipment for Easier Detail Photography with Routine Roentgen Diagnosis Work	*Carl Wegelius* and *Kaj Noschis*	101
On the Technic of Lumbar Pneumomyelography	*Olle Olsson*	107
Über einen interessanten Fall von Mélorhéostosis	*E. Fejér*	112
Accidental Extrapleural Pneumothorax	*Olle Olsson*	117
The Roentgen Examination of the Mediastinal Lung Hernia with Reference to Tomography	*Hans Salinger*	130
The Roentgen Picture of Osteo-Arthritis in the Hip-Joint in Cases of Polyarthritis Rheumatica Chronica	*Ivan Hermodsson*	139
Kymographic Studies of the Function of the Auricle	*Bryan Fabricius*	152
Roentgenological Heart Volume Determination with Special Regard to Pulse Rate and the Position of the Body	*Harry Larsson* and *Sven Roland Kjellberg*	159
Thoracal Aortography by Catheterization from the Radial Artery	*Stig Radner*	178
Thoracic Aortography	*B. Brodén, H. E. Hanson* and *J. Karnell*	181

The Influence of Castration by Roentgen on Carcinoma of the Breast	*Viggo E. Thayssen*	189
Protrusion of the Acetabula as Complication of Labor	*Jens Petersen*	205
The Roentgen Diagnosis of Fluid in the Frontal and Sphenoidal Sinuses	*Dag Turesson*	215
The Use of a Mobile Source of Light in Radiography	*Yrjö V. Paatero*	221
Microcolon	*Johannes Zimmer*	228
Roentgen Examination in Acute Dilatation of the Stomach	*J. Frimann-Dahl*	237
The Treatment of Keloids at Radiumhemmet 1921—1941	*Folke Jacobsson*	251
Solution of Technical Problems Connected with Economical Light-Weight Apparatus for Mass Miniature Radiography	*Kaj Noschis*	268
The Behaviour of the Thrombocytes during and after Local Radiotheraphy	*Harry Mossberg*	277
Roentgendiagnostic Points of View on Spinal Tumours in Children	*Olle Olsson*	279
Mediastinal Abscess Diagnosed by Roentgen	*Sven Roland Kjellberg*	294
A Previously Unreported Sign of Foreign Bodies in the Trachea	*Sven Roland Kjellberg*	300
Widening of the Root Defect in Lumbar Myelogram by Abrodil	*Rasmus Stenström*	303
Water Soluble Contrast Medium for the Precise Roentgenological Diagnosis of Cysts of the Common Bile Duct	*Sven Roland Kjellberg*	307
Anomalies of the Spine in Anomalies of Viscera and Constitution	*Johan Torgersen*	311
The Incidence of Malignant Diseases in Denmark 1942—1944	*Johannes Clemmesen* and *Thøger Busk*	321
A Case of Multiple Tracheal Diverticula	*Karen Nielsen*	331
Contributions on the Roentgenology of the Left Auricle	*B. Wald*	335
Zur Röntgenologie des Ductus thyreoglossus persistens	*W. Güntert*	343
Points Regarding Synovial Fibrosarcoma	*Gunnar Jönsson*	356
Zur Frage des röntgenologischen Nachweises des Senkungsabszesses im Lendengebiet	*C. Buetti*	358
Roentgenologic Changes in the Urinary Bladder and the Distal Portion of the Ureters in Spermatocystitis	*Gunnar Edsman*	371
Jejuno-Gastric Intussusception, A Rare Complication of the Operated Stomach	*Sten Aleman*	383
A Typical Roentgen Picture of Very Large Ureteroceles	*Ulf Rudhe*	396
Contribution à l'Etude Radiologique des Modifications Osseuses et Cutanées Concomitantes dans la Région des Jambes	*René Gilbert* et *Georges Voluter*	403
Cystography with Graduated Compression	*Olle Olsson*	429
The Organisation of Teaching and Research in Medical Physics	*W. V. Mayneord*	435
On Hysterosalpingography and Extrauterine Pregnancy	*Henning Skjoldborg*	456
On the Roentgen Aspect of Prostatic Cancer by Urethrocystography	*Nils P. G. Edling*	461
The Prognostic Significance of Early Diagnosis in Breast Cancer	*Sigvard Kaae*	475
On Lung Changes in Acute General Dermatitis	*Nils Frostberg*	493

A New Protector in Cerebral Angiography	*Arne Engeset*	503
Studies of the Arterial Pulse Wave	*Ake S. Gidlund* and *I. G. Porjé*	509
A Case of Chronic, Non-Specific Jejunitis and Stenosis	*O. W. Husebye*	516
Pneumatosis Cystoides Intestini	*Nils Frostberg*	521
Case of Benign Myoma in the Stomach	*O. W. Husebye*	525
Some Observations on the Roentgen Diagnosis of Non-Opaque Foreign Bodies Aspirated into the Bronchi	*Sölve Welin*	529
Visualization of the Coronary Arteries	*Gunnar Jönsson*	536
The Value of Roentgenography in the Diagnosing of Cardiac Disorder Following Rheumatic Fever	*C. J. Hansson* and *Erik Jacobsson*	541
The Roentgen Examination of the Lingual Tonsil	*Sölve Welin*	546

Index to Volume XXIX.

Roentgen Diagnostics.

Nervous System.

Pag.

Optic Canal in Intracranial Tumor . . . 57
Cerebral Angiography 83, 503
Subdural Hematoma 95
Lumbar Pneumomyelography 107
Spinal Tumours in Children 279
Lumbar Myelogram 303

Digestive Tract.

Jejunitis Acuta Phlegmonosa 71
Microcolon 228
Acute Dilatation of Stomach 237
Cysts of Common Bile Duct 307
Anomalies of Viscera 311
Ductus Thyreoglossus Persistens 343
Jejuno-Gastric Intussusception 383
Chronic Jejunitis and Stenosis 516
Pneumatosis Cystoides Intestini 521
Benign Myoma in Stomach 525

Lungs, Pleura and Mediastinum.

Pleural Effusion in Embolism and Pneumonia 7
Cancer Pulmonaire 19
Hemosiderosis of Lungs 32
Extrapleural Pneumothorax 117
Mediastinal Lung Hernia 130
Mediastinal Abscess 294
Foreign Bodies in Trachea and Bronchi 300, 529
Tracheal Diverticula 331
Lung Changes in Dermatitis 493

Heart and Vessels.

Cerebral Angiography 83, 503
Function of Auricle 152
Heart Volume Determination 159
Aortography 178, 181
Left Auricle 335
Arterial Pulse Wave 509
Coronary Arteries 536
Cardiac Disorder and Rheumatic Fever . 541

Diseases and Fractures of Bones and Joints.

Pag.

Synovial Fibrosarcoma 4, 356
Optic Canal in Intracranial Tumor . . . 57
Mélorhéostosis 112
Osteoarthritis in Hip Joint 139
Protrusion of Acetabula 205
Anomalies of Spine 311
Senkungsabszess im Lendengebiet 358
Modifications Osseuses et Cutanées dans les Jambes 403

Ear, Nose and Throat.

Chronic Mastoiditis 37
Fluid in Frontal and Sphenoidal Sinuses . 215
Lingual Tonsil 546

Urogenital System.

Pyelogenic Renal Cysts 87
Complication of Labor in Protrusion of Acetabula 205
Spermatocystitis 371
Ureterocele 396
Cystography 429
Extrauterine Pregnancy 456
Prostatic Cancer 461

Endocrine Glands.

Ductus Thyreoglossus Persistens 343

Radiotherapy.

Castration in Breast Carcinoma 189
Keloids 251
Thrombocytes after Local Radiotherapy . 277
Breast Cancer 475

Technique.

Roentgen Examination.

Stereo Screen Photography 65
Cerebral Angiography 83, 503

Pag.
Screen Photography (Mass Miniature Radiography) 101, 268
Lumbar Pneumomyelography 107
Heart Volume Determination 159
Thoracal Aortography 178, 181
Mobile Source of Light 221
Water Soluble Contrast for Bile Duct . . 307
Cystography 429
Hysterosalpingography 456
Coronary Arteries 537

General.

Pag.
Malignant Diseases in Denmark 321

Organization.

Teaching and Research in Medical Physics 435

Obituary.

Erik Lysholm 1

List of Authors.

Åkerlund, Åke, 1
Aleman, Sten, 383

Brodén, B. 181
Buetti, C., 358
Busk, Thøger, 321

Clemmesen, Johannes, 321

Diamant, Marcus, 37

Edling, Nils P. G., 461
Edsman, Gunnar, 371
Elgenmark, Olle, 32
Engeset, Arne, 57, 83, 503

Fabricius, Bryan, 152
Fejér, E., 112
de Fleurian, 19
Frimann-Dahl, J., 237
Frostberg, Nils, 493, 521

Gidlund, Åke S., 509
Gilbert, René, 403
Güntert, W., 343

Hanson, H. E., 181
Hansson, C. J., 541
Hermodsson, Ivan, 139
Holm, Harry, 87
Husebye, O. W., 71, 516, 525

Jacobsson, Erik, 541
Jacobsson, Folke, 251
Jönsson, Gunnar, 356, 536

Kaae, Sigvard, 475
Karnell, J., 181
Kjellberg, Sven Roland, 32, 159, 294, 300, 307
Knutsson, Folke, 4
Kvadsheim, Hans, 83

Larsson, Harry, 159
Lilja, Bengt, 37

Mannila, Tauno, 65
Mayneord, W. V., 435
Mathey-Cornat, R., 19
Moberg, Gunnar, 7
Mossberg, Harry, 277

Nielsen, Karen, 331
Noschis, Kaj, 101, 268

Olsson, Olle, 95, 107, 117, 279, 429

Paatero, Yrjö V., 221
Petersen, Jens, 205
Porjé, I. G., 509

Radner, Stig, 178
Rudhe, Ulf, 396

Salinger, Hans, 150
Skjoldborg, Henning, 456
Stenström, Rasmus, 303

Thayssen, Viggo E., 189
Torgersen, Johan, 311
Torkildsen, Arne, 57
Turesson, Dag, 215

Voluter, Georges, 403

Wald, B., 335
Wegelius, Carl, 101
Welin, Sölve, 529, 546

Zimmer, Johannes, 228

Å, Ä, see A

Ö, see O

ERIK LYSHOLM

In Memoriam

Swedish radiology, recently and most unexpectedly, has suffered its as yet perhaps greatest loss. On September 26th 1947, one of its most outstanding and internationally renowned members, Professor ERIK LYSHOLM, Physician-in-chief and Director of the Roentgen Department in the Serafimer Hospital, suddenly passed away at the age of 55 in the midst of his exacting and exceptionally brilliant career as roentgenologist and teacher. His death occurred after but a few days of illness, the

terminal stage of a prolonged nephro-vascular affection borne heroically and not revealed even to his most intimate friends and co-workers until the end.

Barely more than one week previously he had been in full harness at his institute, engaged in the arduous daily routine work, in teaching, in receiving visiting foreign radiologists and in his scientific investigations, which latterly had been concentrated on the utilization of radioactive isotopes in medical radiology and the advancement of clinical ciné-radiology. He passed away in the prime of life leaving behind an aching void within his special field of activity in which, according to human understanding, one might have anticipated many further valuable results from his intuitive perception, eminent skill, unique inventive powers and technical genius.

The outlines of LYSHOLM's life in the service of science are simply and easily recalled. In 1931, when 40 years of age, he was awarded the degree of Doctor of Medicine by a thesis on the special apparatus and precision technique for the roentgen examination of the skull. During the same year he became Assistant Professor of Medical Radiology at the Caroline Institute. He had in the previous year become associated with the Roentgen Department of the Serafimer Hospital in the capacity of assistant chief and assistant teacher in medical radiology under the leadership of Professor GÖSTA FORSSELL; and, when 50 years of age, on FORSSELL's retirement succeeded him as Physician-in-chief and Director. In recognition of ERIK LYSHOLM's distinguished contributions to the science of roentgendiagnostics and technique a personal appointment as Professor in Roentgen diagnosis was conferred upon him at the instance of the Caroline Institute, a chair which at his decease had not yet become, unfortunately, of permanent status in accordance with the requirements of the Institute.

ERIK LYSHOLM published the results of his researches in more than forty outstanding scientific works embracing many widely divergent fields of radiology. Through the »Dedication Volume» (Acta Rad., Vol. XXII, Fasc. 5—6), containing an exhaustive review of his works by the Editor-in-Chief of Acta Rad. and embracing 35 contributions from his pupils and friends, published on the occasion of his 50th anniversary, LYSHOLM's works will undoubtedly be familiar to the readers of this journal.

ERIK LYSHOLM was above all a roentgen-diagnostician and inventor. His greatest achievements were in the systematic development of roentgen diagnosis as applied to neurological diseases in which he obtained universally recognized and unrivalled mastership. His precision technique for the roentgenological demonstration of expansive intra-cranial processes, based on the ability to reduplicate exactly certain standardized

projections made possible by use of the skull table he invented, is universally held to be an exemplary solution to this problem.

By virtue of his even purposeful and precise technical designing, ERIK LYSHOLM gained wide fame and high esteem throughout the international radiological world. It is very probable that there is no well equipped roentgenological department in the whole world which is not daily, or even hourly, making use of the LYSHOLM Stationary Grid which so unprecedentedly improves the quality of radiographs. It is an eloquent witness of his international importance in modern roentgen technique.

Both as a remarkable teacher and as an inspiring and encouraging leader ERIK LYSHOLM will be long remembered. He founded his own famous school and under his guidance a phalanx of young scientists, both Swedish and foreign, have received their fundamental training, most especially in the subtle and difficult field of roentgen diagnosis of the central nervous system.

ERIK LYSHOLM was an exceptional toiler, entirely wrapped up in his various tasks. To him his work was always the essential issue besides which personal interests were of very minor importance, even when these might be to his own advantage in position, promotion or in official honours.

As an indefatigable pioneer, inventor and improver of modern roentgen-diagnostic technique his name will be recorded in the annals of medical radiology. By nature modest and retiring, his sincere and charming personality endeared him to all his friends; and, as a brilliant and original thinker of distinctive individuality, his radiological friends throughout the world will always remember him with both affection and gratitude.

Åke Åkerlund.

FROM THE ORTHOPEDIC CLINIC OF KAROLINSKA INSTITUTET, STOCKHOLM
(PROF. S. FRIBERG)

TWO SYNOVIAL FIBROSARCOMAS[1]

(JÖNSSON)

by

Folke Knutsson

In his doctor's thesis JÖNSSON has clarified the nomenclature of malignant tumours arising in joint capsules, tendon sheaths, and bursas. He divides these malignant synovial tumours into two different groups, namely, synovialomas and synovial fibrosarcomas. These two kinds of tumours show both clinical and micro-anatomical differences. The synovialomas are more malignant and metastasize often to the regional lymph glands, the lungs and the internal organs. The synovial fibrosarcomas, on the other hand, very seldom metastasize to the lungs and other internal organs. The synovialomas, as distinct from the fibrosarcomas, are very responsive to roentgen-treatment.

JÖNSSON points out that the fibrosarcomas sometimes contain calcifications and that is why this form of tumour has a roentgen-diagnostic interest. It is from the roentgen diagnostic point of view that the following two cases will be described.

The diagnosis is difficult but very important. It has been proved that this complaint is generally not diagnosed correctly in the early stages. It is often wrongly interpreted as an inflammatory process. The most characteristic feature is an extreme tenderness though there is no spontaneous ache. Surgical intervention and roentgen treatment are necessary. There is a risk of local recurrences and remote metastases.

In my two cases I could ascertain the diagnosis, synovial fibrosarcoma through the characteristic calcifications. The calcifications consisted principally of sharp-edged shards which proved they were part of the tumour structure. A calcium precipitation in a necrotic tissue should have an uncharacteristic, amorphous appearance.

Case 1. Male patient, born 1908, J. 3482/36. For five years past spontaneous pain by moving the left wrist, strong local ache at the radial side. The pains have gradually increased to such an extent that the patient is now unable to work. No spontaneous pain if he does not move his wrist.

[1] Submitted for publication March 28, 1947.

Fig. 1.

Fig. 3.

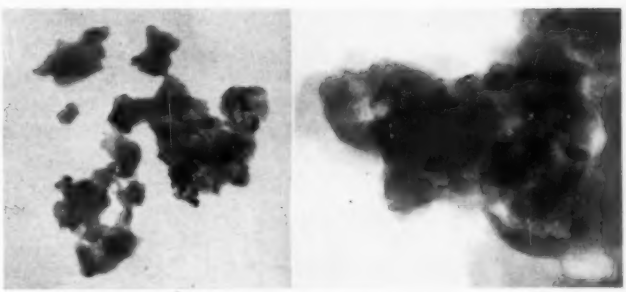


Fig. 2.

Examination on December 12th, 1936 revealed a slight swelling in the tabatière anatomique, but no clear tumour. The patient was very sensitive to pressure. Roentgen examination on November 26th, 1936 disclosed a group of calcifications dorso-radically from naviculare. There were no pathological changes in the skeleton (fig. 1).

In an operation on December 9th, 1936 (FRIBERG) a granular tumour was extirpated. It looked like granulated tissue but was of a more solid consistence. Roentgen examination showed it contained the calcifications, earlier observed (fig. 2). A roentgen examination after the operation showed that all calcifications were gone. P. A. D. Fibrosarcoma containing calcifications and arising in the tendon tissue.

After the operation the patient was quite free from symptoms until the summer of 1938 when his trouble became successively aggravated.

A new roentgen examination on June 6th, 1942 revealed a small group of calcifications where the operation had been performed.

An operation was again performed on June 5th, 1942 (SEVERIN); a recurrence, a grey-white tumour the size of a pea was extirpated. P. A. D. The tumour had exactly the same micro-anatomical appearance as before. There were many calcifications.

After this operation the patient was without symptoms for about a year but since then his pain has returned and become successively worse.

He was sent to Radiumhemmet for roentgen treatment in July 1944. Since then he has been reexamined several times. He has not noticed any subjective recovery from the roentgen treatment. He was examined again on September 25th, 1946. No local recurrence could be palpated. The patient suffers as before from acute pain under pressure and in moving his hand. No metastases could be palpated in the local glands.

Case II. Male patient, born 1918, J. 641/47. Pains in the instep since 1939. The patient felt pain when he put his foot down on the ground and had difficulties in walking. He was roentgen treated but without result. The trouble had successively increased year by year. The patient had had all kinds of physicalic treatment including arch-supports to retract pressure, but without effect.

An examination on January 1st, 1947 showed an acutely painful diffuse resistance in the instep under the plantaraponeurosis and slightly protruding.

A roentgen examination revealed dispersed calcifications which corresponded to the soreness, fig. 3. These calcifications looked like sharpedged shards and had developed since the examination in 1939.

At an operation on February 11th, 1947 (SJÖWALL) a sausage-shaped tumour of solid consistence, 10 centimetres long and 2 centimetres wide was discovered. It seemed to arise in a tendon sheath and was easily dissected out. There was no infiltration into the surrounding tissue.

A roentgen examination showed that the extirpated tumour contained the calcifications, earlier observed. (fig. 2).

SUMMARY

Two synovial fibrosarcomas (JÖNSSON) with characteristic calcifications.

ZUSAMMENFASSUNG

Beschreibung von zwei synovialen Fibrosarkomen (JÖNSSON) mit charakteristischen Kalkablagerungen.

RÉSUMÉ

Description de deux fibrosarcomes synoviaux (JÖNSSON) avec des calcifications caractéristiques.

LITERATURE

JÖNSSON, Malignant Tumors of the Skeletal Muscles, Fasciae, Joint Capsules, Tendon Sheaths and Serous Bursae. Acta Rad. Suppl. 36. Stockholm 1938.

FROM THE ROENTGEN DIAGNOSTIC DEPARTMENT OF THE CAROLINE HOSPITAL, STOCKHOLM
(CHIEF: PROFESSOR ÅKE ÅKERLUND)

EARLY PLEURAL EFFUSION IN PULMONARY EMBOLISM AND PNEUMONIA OR BRONCHOPNEUMONIA[1]

by

Gunnar Moberg

The roentgen diagnosis of pulmonary embolism has previously been based on the demonstration of the characteristic triangular infarct shadow with its base facing the pleura and the apex pointing towards the hilus. In order that the infarct should appear as a triangular shadow on the roentgenogram, however, it would be necessary for the roentgen ray to strike the triangle from the side, at an angle which does not diverge too much from 90 degrees. Otherwise, uncharacteristic appearances which make it impossible to judge the nature of the density are obtained.

More recent investigations have furthermore proved that this wedge-shaped shadow, with the apex towards the hilus, is by no means characteristic of the pulmonary infarct. Thus, HAMPTON and CASTLEMAN published in 1940 a report of an investigation on an autopsy material comprising 370 cases of pulmonary infarction. In these cases, the part of the infarct facing the hilus was, as a rule, not triangular but rounded. SCHINZ (1939) also believed the triangular shadow to be a rare feature of these roentgenograms, and KRAUSE (1945) stated that he had been unable to establish any characteristic form of infarct shadow.

Pulmonary embolism may often occur without any density being demonstrable in the parenchyma of the lung. WESTERMARK considered that in such cases there was ischemia in the blood vessels distal to the embolus. This ischemia, according to him, could appear on the roentgenogram as an area of increased radiolucency in which the vessels in the corresponding part of the lung were less clearly visualized. The demonstration of such a reduction in the size of the blood vessel shadows in cases of pulmonary embolism, where a hemorrhagic infarct has not developed, would no doubt present considerable difficulties in practice.

[1] Submitted for publication, March 28, 1947.

The roentgen diagnosis of pulmonary embolism is thus, for the most part, impossible if it is to be based solely on the observation of parenchymal and vascular changes in the lungs.

Usually pulmonary embolism, and in any case the fully formed pulmonary infarct, leads to changes in the pleura. SCHINZ, in an investigation on 200 autopsies of hemorrhagic infarcts nearly always found a circumscribed, fibrinous, often hemorrhagic pleuritis overlying the infarct. Large serofibrinous, more or less hemorrhagic effusions were rare in this autopsy series.

KRAUSE stated in his paper of 1945 on the roentgen diagnosis of pulmonary infarcts, that the frequent relationship between pleural effusion and infarction should be borne in mind when the diagnosis is being made.

In an endeavour to estimate the significance of early pleural effusion in pulmonary embolism a careful study has been made of cases from the surgical clinic of the Caroline Hospital in which the clinical diagnosis was pulmonary embolism, and where a roentgen examination had been carried out within 3 days of the first appearance of the symptoms. The material consists of 46 patients from the period 1940—1945. The object was to endeavour to ascertain of what significance the diagnosis of an early effusion into the pleura can be for the differential diagnosis between pulmonary embolism on the one hand and pneumonia and bronchopneumonia on the other hand. For purposes of comparison, a study was also made of all the cases of pneumonia and bronchopneumonia treated at the medical clinic of the hospital during 1944, in all 170 patients. Of these, only 38 were submitted to roentgen examination within 6 days of their first symptoms, and only 23 of the latter were roentgenographed within 3 days. The material, it is admitted, is somewhat small, but it may nevertheless furnish some points of interest in a comparison with the embolism series.

In the roentgen examination, the pictures were taken with the patient half sitting up in bed, in cases where it was not possible to move the patients, as so often occurs in suspected pulmonary embolism. Both anteroposterior and lateral views were taken, the latter always with horizontal projection, care being taken to include the posterior wall of the thorax with the posterior sinus in the roentgenograms. In only a few cases were additional films taken with the patient in the lateral recumbent position and a horizontal projection. It was therefore to be expected that the pictures would not always show pleural effusions. This is especially true, perhaps, when there were shadows of increased density in the parenchyma, which in a large number of the embolism cases may have been situated posteriorly and inferiorly at the posterior costo-phrenic angle, where the exudate usually collects when the patient is lying on his back.

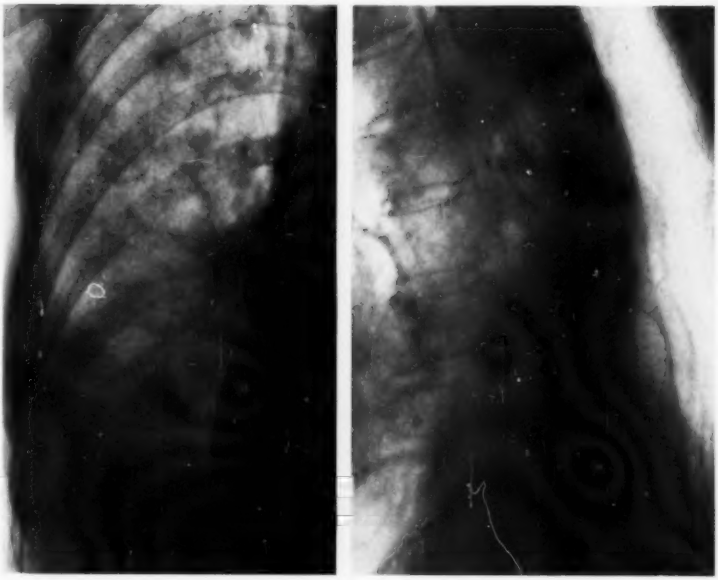


Fig. 1 a. Fig. 1 b.

Fig. 1, a and b. Combined pulmonary embolism and bronchopneumonia. A large shadow of increased density in the postero-basal portion of the right lung. Very small pleural effusion.

Our belief at the beginning was that the presence of fluid in the pleural cavity at an early stage, with either simultaneous absence of parenchymal density, or the presence of only small densities, was typical of pulmonary embolism, while the pleural effusion at the beginning of pneumonia or bronchopneumonia was usually insignificant in relation to the consolidation in the parenchyma.

If this view were correct, we would have here a valuable guide for diagnosis, especially since the signs mentioned by earlier authors as being typical of pulmonary embolism, namely, local ischemia and the triangular shadow in the parenchyma, have proved to be of doubtful value.

Unfortunately, it must be said, after a study of the 46 cases of pulmonary embolism, that the demonstration of an early pleural effusion is of relatively little assistance in the diagnosing of pulmonary embolism.

Of these 46 cases, 21 were found to have a pleural effusion and relatively small or no areas of increased density in the parenchyma. In 4 cases, the pleural effusion and the parenchymal density were about equally prominent, and in 2 cases the relation was uncertain. In 19 cases the

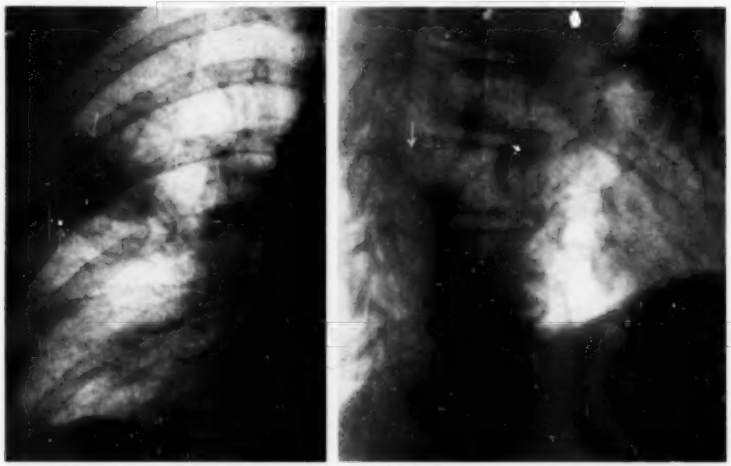


Fig. 2 a. Fig. 2 b.

Fig. 2 a. A case of pulmonary embolism. A triangular parenchymal density is marked by arrows.

Fig. 2 b. Same case as fig. 2 a. An area of increased density chiefly of a pleural nature in the posterior inferior part of the right chest.

density in the parenchyma was distinctly the dominant feature in relation to the pleural effusion.

An objection that might be made to the material in question is that the diagnosis of pulmonary embolism was not absolutely established in a large number of cases. A sudden acute pain in the chest and a moderate temperature elevation speak strongly in favour of embolism when they appear within the specified time after operation when pulmonary embolism is known to occur, even though a more definite state of shock with cyanosis, dyspnoea, and tachycardia, as well as bloody sputum and signs of thrombosis in other parts of the body, are absent.

In a number of cases the clinical picture was not clear owing to the presence of infections of various kinds.

A combination of pulmonary embolism and bronchopneumonia must also be expected in some cases. Such a patient died and was submitted to autopsy seven days after the last roentgen examination. The patient was a woman of 81 (K 612/1942) whose lower legs had been amputated 2 months apart for gangrene in both feet following arterial embolism. Clinical signs of thrombosis appeared in the right leg and on two occasions she had symptoms of embolism in the chest, once a sharp pain, and once dyspnoea alone. On one occasion, also, she coughed up bloody sputum.

Fig. 3 a.

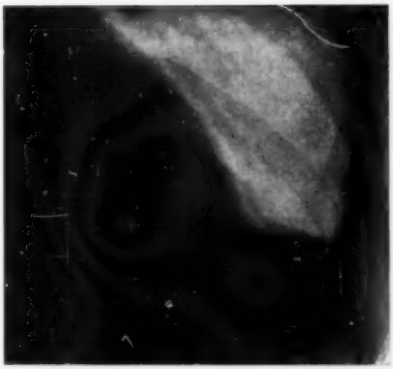


Fig. 4.

Fig. 3 b.

Fig. 5.

Fig. 3, a and b. A case of pulmonary embolism. A pleural density is visible in the left costo-phrenic angle laterally and posteriorly.

There is a triangle-shaped parenchymal density posteriorly and inferiorly, with its apex towards the hilus.

Fig. 4. A case of pulmonary embolism. A parenchymal density, marked by arrows, is visible laterally towards the left base, at the arch of the diaphragm.

Fig. 5. A case of pulmonary embolism. There is fluid in the left costo-phrenic angle posteriorly marked by arrows.

Fig. 6. A case of pulmonary embolism. A parenchymal density is visible in the right lower lobe posteriorly and inferiorly. There is a small parenchymal density in the lower part of the middle lobe. There is also a 1 centimeter wide pleural density along the thorax wall, on the left side (in the extreme left of the picture).

She ran a low fever the whole time, with a small rise in temperature about 2 months before she died in connection with a cough of a few days' duration. At that stage, there were no definite signs of pulmonary embolism. Roentgen examination revealed a fairly large shadow of increased density in the lung parenchyma, situated posteriorly at the right base but no clear evidence of fluid in the pleura. The last roentgen examination 7 days before autopsy and one day after the patient had begun to suffer from dyspnoea also showed an area of density in the posterobasal portion of the right lung, and a small pleural effusion, but the parenchymal density was more prominent (fig. 1 a and b). Autopsy revealed emboli in the pulmonary artery, and a triangle-shaped bronchopneumonic area, with the apex at the site of the embolus.

It is unfortunately impossible to say with certainty what was the cause of the parenchymal density at the time of the examination, in this case and in the other 18 cases where this feature was more prominent than the pleural effusion. In all these cases the area of density was located in the posterior inferior part of the lung. The opportunities for the development of infarction in this area ought to be greater because of the hypostasis occurring in these areas in recumbent patients. On the other hand, the same factor, as well as the favourable conditions here for an accumulation of secretion, are thought to encourage the occurrence of bronchopneumonia in the same area. It seems however very unlikely that bronchopneumonia alone, or in combination with embolism was responsible for this parenchymal density in all these cases.

Even if we cut down this clinical material of probable pulmonary

Fig. 7 a.

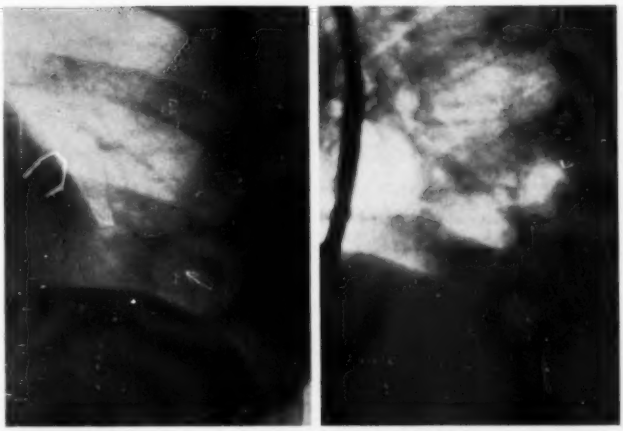


Fig. 7 b.

Fig. 7 c.

Fig. 7 a and b. A case of bronchopneumonia. A parenchymal density is visible in the left costo-phrenic angle posteriorly.

Fig. 7 c. Same case as figs 7 a and 7 b. A movable fluid layer $^1/_2$ cm. in width, is visible with the patient in the left lateral recumbent position.

embolism by removing all cases where the diagnosis was in any way uncertain as well as all patients who have had operations on gallbladder or stomach, such patients often presenting secondary changes in the pleura and lung parenchyma, we still find approximately the same proportion between the different groups among the remaining definite 23 cases: thus, 12 cases with predominance of the pleural effusion, 1 with parenchyma and pleura involved to an approximately equal degree, 9 cases where the density in the parenchyma is the dominating feature and 1 where the relation is uncertain.

Comparing now the conditions in the series of 38 cases of pneumonia and bronchopneumonia from the medical clinic where a roentgen examination was made within 6 days of the appearance of the acute pneumonia symptoms, we find that the density in the lung parenchyma was the predominating feature in 33 cases, densities in parenchyma and pleura were about equally dominant in 3 cases, and the pleural effusion was the most pronounced feature in 2 cases. Of these 38 cases, 23 were examined

Fig. 8 a.

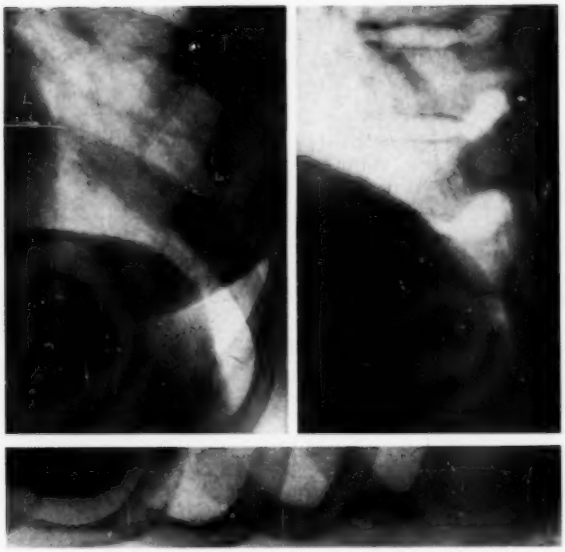


Fig. 8 b.

Fig. 8 c.

Fig. 8 a, b and c. Same case as fig 7, 3 weeks later. The parenchymal and pleural densities have completely disappeared.

within 3 days of their first symptoms. Of these 23 cases, density in the lung parenchyma was the dominating roentgenologic feature in 18 cases, parenchymal density and pleural effusion were equally prominant in 3 cases, and the pleural effusion was the dominating feature in 2 cases.

Concerning the cases of pneumonia and bronchopneumonia from the medical clinic, there was not the same degree of uncertainty regarding the clinical diagnosis as there unfortunately was in some of the pulmonary embolism cases from the surgical clinic. In the majority of cases it was a matter of sudden, acute symptoms with fever in persons previously healthy, and there was therefore no reason to suspect pulmonary embolism.

In this material we also find some cases where the diagnosis was not entirely certain. One of these will be described briefly. The case was that of a 21-year-old junior hospital nurse (M 1590/1944) who had previously been in good health, and who fell ill on Aug. 14, 1944, with a sharp pain in her left side on taking deep breath. There was no cough or fever. Roentgen examination on August 16, 2 days after the first symptoms, revealed a small cloudy area of consolidation in the base of the left lung parenchyma posteriorly (figs 7 a and 7 b). In the roentgeno-

Fig. 9 a.

Fig. 9 b.

Fig. 9 a. A case of bronchopneumonia. The lung markings are increased towards the base of the left lung.

Fig. 9 b. Same case as fig 9 a. A movable fluid layer, $^1/_2$ centimeter wide, is visible with the patient in the left lateral recumbent position.

gram taken with the patient in the left lateral recumbent position there was a layer of fluid, half a centimeter in width, along the wall of the thorax on the left side (fig 7 c). Roentgen examination on Sept. 7, 1944, 3 weeks later, showed that the lesions had completely disappeared (figs. 8 a, 8 b, 8 c). In the lateral view, it was seen that both posterior sinuses were absolutely clear. No fluid was now visible in the left lateral recumbent position (8 c)

The patient had been Mantoux-negative in February 1944, and the same month she was vaccinated with BCG, with a positive result. A Mantoux test on Aug. 26, 1944, with 0.1 mg., gave a halo and infiltrate, 12 × 15 mm. in size, after 72 hours. The sedimentation rate was 14 mm. in 1 hour on August 21 and 7 mm. in 1 hour on August 28. White blood cell count on August 21, 2,800.

Thus, there was nothing found at the clinical examination to point to bronchopneumonia. The same signs and symptoms, if they had occurred after an operation, would have been interpreted as being indicative of pulmonary embolism. The case was nevertheless included in the bronchopneumonia material, although it is, perhaps, as well to take into account the possibility that pulmonary embolism may occur also in young persons not confined to bed and displaying no clinical signs or symptoms. The rapid disappearance of the pulmonary lesions, as well as the quick return of the sedimentation rate to normal values and a negative result from a guinea-pig test with gastric lavage fluid were regarded as evidence against tuberculosis. This case is one of the three in the bronchopneu-

monia series in which pleural effusion and parenchymal density were equally dominating features of the roentgen picture.

A case illustrating how a pleural effusion can occur in a respiratory tract infection with uncertain or very slight parenchymal densities in the lungs will also be described here. The patient was a woman of 21 (M 622/1944) who became ill on March 28, 1944, with coryza, a cough, and a fever around 40° C. On March 29 she still had a high temperature and slight sticking pains in her left side. She was treated with sulfa drugs and her temperature dropped on March 30. Sedimentation rate on March 29, 33 mm. in 1 hour. On auscultation, a few scattered dry râles were heard at the base of both lungs, as well as a slightly weakened respiratory sound and a few friction rubs at the base of the left lung. Roentgen examination on March 29, 1 day after the first symptoms, revealed nothing but slightly exaggerated lung markings at the base of the left lung (fig. 9 a) and with the patient in the left lateral recumbent position a $^1/_2$ cm. wide, movable fluid layer was visible (9 b). Thus, here, the fluid in the pleura was a more dominant feature than the density in the parenchyma. From March 31 and onwards the patient was completely afebrile, and she was discharged on April 4, 7 days after she fell ill, free from all signs and symptoms.

This last case is of some interest, since it confirms an observation made by LÖFSTEDT, that pleural effusion may occur in non-specific respiratory tract infections where no definite roentgenologic evidence of parenchymal density has been obtained.

Summarizing, it must be admitted that the investigation yielded nothing especially positive. What can be said, however, is that an early pleural effusion, when there are no, or only small parenchymal densities, is common in postoperative pulmonary embolism but less common in a medical series of pneumonia and bronchopneumonia cases. Relatively large parenchymal densities without demonstrable pleural effusion, or with a relatively slight pleural effusion seem, however, to occur in a not inconsiderable proportion of pulmonary embolism cases.

It is therefore highly desirable that better methods for differential diagnosis between pulmonary embolism and pneumonia or bronchopneumonia than those we now possess in the roentgen examination should be worked out. It is possible that, as LÖFSTEDT has suggested, aspiration of the exudate in pulmonary embolism and bronchopneumonia, and microscopic examination of the samples obtained, might furnish better possibilities for differential diagnosis.

SUMMARY

46 cases of pulmonary embolism, roentgenographed within 3 days of the appearance of the symptoms, and 38 cases of pneumonia or bronchopneumonia examined with 6 days of onset have been studied for the purpose of ascertaining whether an early pleural effusion can be considered of any significance from the differential diagnostic standpoint. Among the pulmonary embolism cases the pleural effusion dominated over the parenchymal density in approximately one-half of the cases, while the reverse was true in not quite half. Among the 38 cases of pneumonia and bronchopneumonia the pleural effusion dominated in 2 of the cases, and in 3 cases pleural effusion and parenchymal density were equally dominant. All of these 5 patients, like the embolism cases, were examined within 3 days of the first symptoms. In the other 33 cases, 18 of which were examined within 3 days, the parenchymal density was the dominating roentgen finding.

A remarkable feature is that pleural effusion is sometimes seen in acute, non-specific respiratory tract infections, when no, or only small parenchymal densities are visible on the roentgenogram.

ZUSAMMENFASSUNG

46 Fälle von Lungenembolie, die innerhalb 3 Tagen nach Auftreten der Symptome röntgenuntersucht wurden, und 38 Fälle von Pneumonie-Bronchopneumonie, die innerhalb 6 Tagen untersucht wurden, wurden im Hinblick auf die Beurteilung durchgesehen, ob einem früh auftretenden Pleuraerguss eine differentialdiagnostische Bedeutung beizumessen ist. Bei den Fällen von Lungenembolie dominierte der Pleuraerguss in etwa der Hälfte der Fälle über die Parenchymverdichtung, während letztere in kaum der Hälfte der Fälle dominierte. Unter den 38 Pneumonie-Bronchopneumoniefällen dominierte der Pleuraerguss in 2 der Fälle, und in 3 Fällen waren Pleuraerguss und Parenchymverdichtung ebenso vorherrschend. Alle diese 5 Fälle waren, wie die Emboliefälle, innerhalb 3 Tagen nach Auftreten der Symptome untersucht. In den übrigen 33 Fällen, von denen 18 innerhalb 3 Tagen untersucht wurden, dominierte die Parenchymverdichtung.

Bemerkenswert ist, dass sich der Pleuraerguss manchmal bei akuten, unspezifischen Luftwegsinfektionen nachweisen lässt, wo röntgenologisch keine oder doch nur unbedeutende Parenchymverdichtungen nachzuweisen sind.

RÉSUMÉ

Quarante-six cas d'embolie pulmonaire, radiographiés dans les trois jours depuis l'apparition des symptômes, et trente-huit cas de pneumonie ou de bronchopneumonie, examinés dans les six jours à partir du début, ont été étudiés dans l'intention de s'assurer si un épanchement pleural précoce peut être considéré comme ayant quelque signification du point de vue du diagnostic différentiel. Parmi les cas d'embolie pulmonaire, l'épanchement pleural l'emportait sur l'opacification du parenchyme dans à peu près la moitié des cas, alors que l'inverse existait dans un peu moins de la moitié. Sur les trente-huit cas de pneumonie ou de bronchopneumonie, l'épanchement pleural était prédominant chez deux malades, et chez trois l'épanchement pleural et l'opacité du parenchyme étaient d'importance égale. Tous ces cinq malades, comme les cas d'embolie pulmonaire, furent examinés dans les trois premiers jours. Dans les trente-trois autres cas, dont dix-huit furent examinés dans les 3 premiers jours, l'opacité du parenchyme était la constatation radiologique prédominante.

Un fait remarquable, c'est qu'un épanchement pleural s'observe parfois dans des infections aiguës, non spécifiques, du tractus respiratoire alors qu'il n'y a point, ou seulement de petites, opacités parenchymateuses visibles sur la radiographie.

REFERENCES

HAMPTON, A. O., and CASTLEMAN, B.: Correlation of postmortem chest teleroentgenograms with autopsy findings with special reference to pulmonary embolism and infarction. Am. J. of Roentgenology 43: 305—325, 1940.

KRAUSE, G. R.: The roentgen diagnosis of pulmonary infarcts. Radiology 45: 107, 1945.

LÖFSTEDT, S.: Personal communication.

SCHINZ, BAENSCH, FRIEDL: Lehrbuch der Roentgendiagnostik, Leipzig 1939.

WESTERMARK, N.: On the roentgen diagnosis of lung embolism. Acta Radiologica 19: 357, 1938.

SERVICE CENTRAL DE RADIOLOGIE DES HÔPITAUX PELLEGRIN-LE TONDU, BORDEAUX,
DÉPARTEMENT DE RADIODIAGNOSTIC (CHEF: DR. R. MATHEY-CORNAT)

SUR LA PATHOLOGIE ET LE DIAGNOSTIC RADIOLOGIQUE DU CANCER APICAL PULMONAIRE ET DES TUMEURS MALIGNES PÉRI-APICALES[1]

(Syndrome de PANCOAST et TOBIAS)

par

R. Mathey-Cornat et *de Fleurian*

Les tumeurs étudiées dans cet article, bien que de nature histologique diverse, ont des caractères communs, cliniques et radiologiques, qui permettent de les différencier des autres tumeurs malignes pulmonaires.

Ces signes réunis forment un syndrome que l'on retrouve dans chaque observation et que l'ont peut décrire sous le nom de syndrome de Pancoast et Tobias.

C'est en effet PANCOAST, de Philadelphie, qui en a donné en 1924 une description originale, ébauchée il est vrai, avant lui par RICALDONI. En France, dès 1928, l'attention avait été attirée sur les signes oculo-pupillaires sympathiques, en particulier sur le signe que nous dénommons de CLAUDE BERNARD-HORNER et qui avait été décrit et dans le cancer lobaire supérieur et dans la tuberculose apicale.

En 1931, paraissait la thèse de TOBIAS sur »le syndrome apico-costo-vertébral douloureux» déterminé par une tumeur apicale pulmonaire. On y trouvera de nombreux documents auxquels on voudra bien se reporter. COURCOUX et LEREBOULLET, de Paris, à la même époque, rapportent un cas d'association de la tumeur maligne apicale à la tuberculose. En 1936, GUILLAIN et STERNE, dans les Annales de Médecine, étudient la forme neurologique du cancer apical, forme caractérisée par une paralysie douloureuse du plexus brachial avec signe de CLAUDE BERNARD-HORNER.

A dater de ces monographies, le cancer apical pulmonaire a commencé à être mieux identifié et des auteurs divers, anglo-saxons, sud-américains notamment, ont apporté quelques observations originales.

[1] Soumis à la Rédaction le 10 Avril 1947.

TEYSSIER les a réunies dans sa thèse de Paris 1942, en y ajoutant une documentation personnelle: au total, 88 observations.

Récemment, d'autres observations, celles de STEIN, celles rapportées à la Société Médicale des Hôpitaux de Paris et les nôtres rapportées dans une thèse de Bordeaux 1945 ainsi qu'à la Société de Radiologie Médicale de France, ont apporté un jour nouveau sur la question. Nous avons pu identifier ainsi un total de 92 observations, ce qui montre que le syndrome de Pancoast et Tobais n'est pas exceptionnel et qu'il doit désormais être mieux connu des médecins et des spécialistes.

Les tumeurs qui sont à l'origine de ce syndrome ont un siège assez fixe, à savoir l'apex pulmonaire et les éléments anatomiques voisins. On les situe dans la fossette sus- et retro-pleurale et la partie haute de l'angle costo-vertébral. Le syndrome est composé de signes cliniques, neurologiques et accessoirement pleuro-pulmonaires; les signes radiologiques tiennent une grande place. Notre intention est de reprendre, à la faveur des observations mentionnées ci-dessus, les points les plus importants de la pathologie et du diagnostic radiologique du syndrome sur lesquels les travaux antérieurs sont assez peu explicites, alors que la partie clinique a été complètement exposée.

Nous espérons montrer que grâce aux techniques radiologiques actuelles et à la tomographie, il pourra être possible de préciser le siège exact de la lésion et de la détecter plus tôt. Peut-être alors pourrons-nous instituer un traitement plus efficace?

I. Le syndrome de Pancoast et Tobias

Rappelons en quelques traits les dominantes de ce syndrome.

L'affection débute, dans la majorité des cas, par des signes douloureux radiculaires. Les hommes sont particulièrement affectés, dans 85 à 90 p. 100 des cas, et l'âge adulte, de 40 à 55 ans paie le plus lourd tribut.

On a constaté que chez la femme, la tumeur apicale était souvent révélatrice d'une métastase (épithelioma du col, de la glande mammaire, hypernéphrome). Le début est progressif mais l'évolution rapide à partir d'un certain moment. Les douleurs ont le caractère de névralgies avec paroxysmes: elles siègent dans le territoire nerveux des dernières racines du plexus brachial, de C. VIII à D. I et s'irradient vers le bord cubital de la main et les derniers doigts. Elles s'accompagnent de troubles sensitifs et moteurs pouvant aller jusqu'à la paralysie.

L'atrophie musculaire existe parfois et l'exploration électrologique ou la chronaxie en détermine les modalités.

Des signes sympathiques parfois précoces traduisent la prise du ganglion stellaire et des rami communicantes des dernières racines du plexus brachial. Il se traduisent par un signe de CLAUDE BERNARD-HORNER

du côté atteint, comme il a déjà été dit, avec ou sans troubles vasomoteurs.

Il peut se faire que des signes d'irritation sympathique apparaissent les premiers (signe de Pourfour du Petit), le CLAUDE BERNARD-HORNER n'apparaissant que secondairement. Quand les signes sont au complet, on est en présence d'une paralysie radiculaire inférieure brachiale du type Déjerine-Klumpke.

L'exploration physique peut mettre en évidence des signes sus-claviculaires généralement plus tardifs et consistant en un empâtement diffus du creux sus-claviculaire ou une adénopathie type Troisier. Les signes thoraciques sont plus ou moins constants: tuméfaction para-vertébrale occupant la fosse sus-épineuse, contracture douloureuse de la paroi, signes de condensation du sommet. La paraplégie représente un accident terminal par compression médullaire ou métastase. L'évolution est souvent apyrétique mais rapide, de quatre à dix-huit mois dans nos observations.

L'exploration radiologique doit être menée systématiquement. Elle peut conduire à un diagnostic précoce. On ne saurait trop s'y attacher. La radioscopie donne une utile orientation et permet d'apprécier les troubles de ventilation du sommet, du lobe supérieur, et les anomalies de la dynamique respiratoire et médiastinale.

Les techniques radiographiques doivent être conduites avec méthode et orientées en conséquence, en tenant compte des cas d'espèce. La technique standard ne donne qu'une première approximation. Il faut la compléter par des incidences spéciales obliques ou latérales du sommet et par une obliquité variable du rayon incident dans la direction craniale ou dans la direction caudale, de manière à effacer la projection de la clavicule et à dégager tout le sommet pulmonaire. Ceci facilite beaucoup l'interprétation des radiogrammes et permet de résoudre des problèmes difficiles du diagnostic radiologique surtout si l'on y adjoint des séries radiographiques prises à peu d'intervalle et des tomographies frontales et latérales.

La formation des images radiologiques peut être schématiquement décrite comme suit.

Au stade de début, on observe une *opacité en disque* ou en *croissant*, très limitée, et qui n'intéresse que la partie supérieure du dôme pleural. Il s'agit d'une opacité homogène, de densité infra-costale et qui vient s'appuyer sur l'arc postérieur de la première et quelquefois de la deuxième côte. On doit y prêter la plus grande attention, l'observer à la loupe, et par rapport au côté sain opposé. Ce »croissant» sombre se prolonge en dedans jusqu'à l'articulation costo-transversaire correspondante et en dehors jusqu'au recoupement du bord supérieur de la clavicule. Il peut être éclairé de quelques aréoles qui se détachent sur le périoste de la côte.

C'est à ce stade qu'il est primordial de penser au cancer apical si l'on

est en présence du syndrome neurologique douloureux que nous avons cité plus haut et de ne pas se contenter d'un diagnostic d'arthrite, de névralgie ou de simple pleurite apicale.

Le »croissant» sombre en effet progresse inéluctablement dans le cas de lésion maligne et l'on peut estimer qu'un certain pourcentage de cas qui ont été diagnostiqués comme appartenant à une tuberculose apicale et qui ont évolué avec rapidité, n'étaient autres que des tumeurs malignes apicales méconnues.

Dans des cas plus favorables d'emblée, ou ultérieurement, la technique radiologique peut mettre en évidence la *tumeur* elle-même. Elle est généralement sphérique ou ovoïde, au sein d'un bloc d'atélectasie, avec des limites plus ou moins régulières ou des ramifications ténues en »pattes de crabe». On ne peut la découvrir que par les incidences spéciales de dégagement du sommet. Elle progresse de l'apex vers la région infra-claviculaire, c'est-à-dire de haut en bas. Cette distinction évolutive est très importante à constater pour marquer l'origine de la tumeur et contribuer à son identification.

Dans la plupart des cas, la tumeur n'est repérée que lorsqu'elle a déjà évolué pendant quelques mois. Elle constitue alors une opacité massive de toute la région apicale contigüe à la face latérale du rachis, avec ou non un prolongement sous-claviculaire et un prolongement rachidien qui ne peut être reconnu que par des techniques spéciales, incidence oblique, tomographie, myélographie haute.

Au-dessous d'elle, on peut observer un emphysème bulleux. L'atélectaisie associée est plus ou moins importante.

Enfin, des destructions osseuses des premières côtes sont assez généralement constatées. Elles peuvent être assez précoces dans les tumeurs qui siègent à l'émergence des trous de conjugaison. Elles sont plus tardives dans les tumeurs du sulcus de Pancoast. Elles se traduisent par une ostéolyse plus ou moins diffuse des arcs de la première, de la deuxième et quelquefois de la troisième côte. Il faut les rechercher dans le détail. Dans les formes évoluées, la destruction est massive, de la première à la quatrième côte.

La tomographie est d'autant plus précieuse comme moyen diagnostique, que la technique radiologique habituelle se heurte, comme on le sait, aux difficultés inhérentes à l'exploration de la région apicale masquée, latéralement, par le massif scapulaire. Elle est utile pour l'étude du rachis latéral et des connexions de la tumeur avec les orifices de conjugaison. Elle établit une utile distinction entre les tumeurs apicales proprement dites et les tumeurs péri-apicales se profilant dans le médiastin supérieur, à la base du cou, vers l'espace intra-rachidien.

Dans un cas de MAHOUDEAU et COURJARET, il a été possible par la tomographie d'identifier une tumeur apicale qui donnait lieu à un syndro-

me de PANCOAST et TOBIAS et qui se révéla comme étant un gros abcès froid tuberculeux. La coupe était démonstrative à 9 centimètres.

La bronchographie apicale est d'une technique difficile et parfois aléatoire. Dans les cas favorables elle a montré une bronchosténose signant un cancer bronchiolaire. La bronchosténose n'est pas toujours complète même dans le cancer bronchique apical, du moins à son stade de début.

Dans quelques très rares cas, *la bronchoscopie* a permis de découvrir une petite tumeur d'une bronche souche ou d'une bronche de deuxième ordre dans un syndrome de Pancoast et Tobias. L'opacité apicale devait être en rapport avec une métastase.

II. Le syndrome peut être incomplet suivant le siège primitif de la tumeur

Le syndrome de PANCOAST et TOBIAS est déterminé par les tumeurs malignes ayant envahi la région péri-apicale. Il est conditionné par l'origine apicale de la tumeur, tous les organes de l'apex thoracique, tant radiculaires que sympathiques, se trouvant au contact du dôme pleural, dans la fossette sus- et retro-pleurale et l'angle costo-vertébral.

Pour que ce syndrome soit complet, il faut donc que l'apex pulmonaire (ombre radiologique) et la région péri- et sus-apicale (signes neurologiques) soient envahis par la tumeur maligne.

Or, dans un certain nombre d'observations, le syndrome n'est pas complet, soit au début de l'évolution, ce qui se conçoit, soit pendant tout le cours de celle-ci.

En effet, suivant, son point de départ, la tumeur peut envahir d'abord les tissus péri-apicaux en respectant le poumon ou ne l'intéresser que tardivement. L'image radiologique est alors une image d'emprunt, péri-apicale ou costo-vertébrale, dans laquelle l'atélectasie et les lésions osseuses des premières côtes, apparaissent prédominer. L'opacité apicale peut être tellement discrète qu'elle passe facilement inaperçue. Il existe même des observations où la nécropsie a montré l'intégrité du sommet pulmonaire.

Dans d'autres cas, la tumeur ayant un développement apical, les signes radiologiques que nous avons décrits plus haut, prédominent sur les signes neurologiques.

D'autres symptômes enfin ont été décrits dans ces tumeurs. Ce sont des modifications du pouls, de l'oedème du côté malade par compression des vaisseaux sous-claviers. Dans la localisation gauche, on a vu survenir de l'angor pectoris (irritation stellaire). La paralysie phrénique n'est pas rare. Des signes de compression médiastinale sont aussi observés. Une tuberculose peut évoluer simultanément.

III. Le syndrome de Pancoast et Tobias peut être produit par des tumeurs differentes, tant par leur siège que par leur nature histologique

Malgré une certaine unité nosologique, le syndrome de PANCOAST et TOBIAS peut reconnaître des origines diverses, soit que la tumeur qui le détermine ait un point de départ apical proprement dit, soit qu'il s'agisse d'une tumeur péri-apicale respectant le sommet pulmonaire ou ne l'envahissant que secondairement, soit qu'il s'agisse enfin d'une métastase de tumeur distante.

I. — Le plus souvent, d'après nos observations et l'ensemble des statistiques, la tumeur en cause est un épithélioma bronchique, épithélioma d'une bronchiole apicale ou *cancer bronchiolaire périphérique*. Elle donne des signes de condensation pleurale marginale, de condensation pulmonaire primitivement très localisée avec atélectasie intéressant progressivement une partie du lobe supérieur. De sorte qu'à un stade avancé, il devient parfois impossible de différencier un cancer lobaire supérieur d'un cancer apical proprement dit.

Parfois, on est en présence d'une métastase apicale d'un cancer bronchique d'un autre lobe. Dans ces cas, la bronchoscopie peut déceler un bourgeon néoplasique sur une bronche souche ou secondaire.

Fréquemment, c'est un adéno-carcinome ou un épithélioma cylindrique ou un épithélioma malpighien atypique.

POLICARD et GALY classent les cancers bronchiques en épithéliomas indifférenciés, à petites cellules, les plus fréquents, épithéliomas à cellules plus différenciées que l'on observe chez les sujets âgés et qui sont fréquents chez les femmes et dont le siège le plus habituel est au niveau des bronches secondaires ou même des bronchioles.

Il existe enfin des épithéliomas très différenciés qui présentent tous les aspects des épithéliomas malpighiens, comme il a été dit plus haut.

Le cancer prolifère dans la lumière bronchique, d'où la traduction radiologique de la bronchosténose. L'envahissement se poursuit dans les gaines péribronchiques suivant les trajets broncho-vasculaires qui peuvent être visibles radiologiquement (prolongements en »pattes de crabe»).

Après s'être épanché hors de la gaine péribronchique, le cancer envahit le parenchyme pulmonaire et cette extension est plus ou moins bridée par des dispositions histologiques du tissu pulmonaire tels que les trajets fibreux, les cloisons périlobulaires, les gros vaisseaux, les scléroses.

La sclérose péri-tumorale est une réaction d'enkystement du tissu conjonctif par devant la tumeur. Sa formation explique l'ombre tumorale radiologique. L'oblitération progressive des vaisseaux favorise également la sclérose pulmonaire péritumorale: la zone de densité pulmonaire radio-

logiquement mise en évidence, est donc toujours plus étendue que la tumeur elle-même.

II. — Les tumeurs primitivement *péri-apicales* sont peut être plus rares ou moins bien identifiées jusqu'à ce jour. La tomographie a montré leur développement en bissac, l'une des masses néoplasiques appartenant au creux sus-claviculaire, l'autre à l'apex proprement dit avec large participation du dôme pleural. On voit aussi des prolongements à travers les orifices de conjugaison vers le canal rachidien (prolongement en »casque« ou en »cimier«).

Dans deux observations de FREEMAN-RAIMONDI et PARDAL, le diagnostic d'endothéliome pleural avait été porté mais l'interprétation histologique reste douteuse. Dans plusieurs cas, on identifia un sympathoblastome et dans un cas un carcinome thymique. Dans deux cas de FRIED, la tumeur épithéliale qui avait respecté la plèvre et le poumon s'était développée dans la zone péri-apicale et l'auteur pensait, comme PANCOAST, qu'il s'aggissait de tumeurs malignes embryonnaires, du type des tumeurs branchiales ou branchiomes.

En fait, dans un assez grand nombre de cas, la nature et le siège du néoplasme n'ont pu être déterminés malgré l'autopsie et l'examen histologique: ces tumeurs, des épithéliomas pour la plupart, forment un groupe d'attente.

III. — Des tumeurs diverses peuvent donner dans la région apicale et sus-apicale des *métastases* qui réalisent le syndrome de PANCOAST et TOBIAS. Ce sont des cancers du sein, des cancers de l'estomac, du col utérin, des sarcomes (STEIN), des hypernéphromes (BROWDER), un tératome testiculaire (TOBIAS).

Il est aussi démontré d'après les statistiques de STEIN, D'EVANS, FROST et WALPAW, BROWDER, TEYSSIER, et d'après nos observations que d'autres tumeurs que celles précédemment dénombrées peuvent donner le syndrome décrit, à savoir des neurinomes des gaines rachidiennes, des tumeurs malignes lymphoïdes, la lymphogranulomatose de HODGKIN.

IV. Diagnostic

Des examens systématiques de dépistage radiologique peuvent révéler une anomalie apicale. Il faut aussitôt recourir aux techniques radiologiques qui s'imposent pour la mise en évidence de la lésion suspectée.

Nombreuses sont les affections qui peuvent donner, en outre, des signes neurologiques du côté du membre supérieur ou des signes radiculosympathiques. Le diagnostic sera d'autant plus difficile que tous les élements du syndrome de PANCOAST et TOBIAS ne se trouvent pas toujours réunis.

Il convient de s'attacher, comme nous l'avons dit, au diagnostic précoce alors que cliniquement, il n'existe que des signes de radiculite brachiale. L'exploration radiologique doit porter non seulement sur les sommets pulmonaires mais aussi sur le rachis cervical. Le signe radiologique de »ménisque apical» et l'atteinte des premières côtes sont déterminants pour l'évolution maligne.

Le radiodiagnostic lipiodolé ou au per-abrodil devient nécessaire en présence d'un syndrome de compression médullaire haute. La compression du plexus par une côte cervicale est également écartée par le radiodiagnostic.

Malheureusement, le malade n'est pas toujours radiographié au stade de début ou bien l'image première en »ménisque» ou en »croissant» est passée inaperçue. L'examen radiologique à une période plus avancée montre l'opacité de tout le lobe apical avec extension sus-claviculaire ou médiastinale supérieure.

Comment interpréter l'image radiologique? L'atélectasie par bronchosténose ne suffit pas à expliquer tous les cas. Elle joue un rôle majeur dans la formation de l'image lorsque la sténose bronchique ou bronchiolaire est complète avec hyperémie du territoire intéressé: d'où l'aspect cunéiforme bien connu du segment bronchopulmonaire ou de la zone.

Mais la tumeur et la sclérose péri-tumorale sont en cause dans bien des cas et leur image se reconnaît sur des radiogrammes spéciaux ou sur les tomogrammes, donnant une ombre arrondie, dense, tranchant sur le fond homogène du parenchyme condensé. Ce serait, dit LECOEUR, la surimpression sur l'image de condensation pulmonaire rétractile, de l'image propre du cancer.

La tomographie permet d'isoler sur divers plans, en coupe frontale ou en coupe sagittale, la tumeur apicale et le processus péri-apical. Elle donne les rapports de la tumeur avec le médiastin, les métastases, les rapports avec l'angle costo-vertébral et les trous de conjugaison.

Le pneumothorax diagnostique s'est montré constamment impraticable dans ces cas étant donné la pachypleurite ou la symphyse pleurale primitive avec participation du dôme, dans tous ces cas de syndrome apical ou de tumeur du sulcus.

V. Techniques radiologiques

L'examen radiologique classique doit être complété par des incidences spéciales de dégagement du sommet. Nous rappelons les principales incidences. Elles comprennent des incidences antéro-postérieures obliques, des incidences de profil et des incidences axiales. Nous ne faisons que les mentionner.

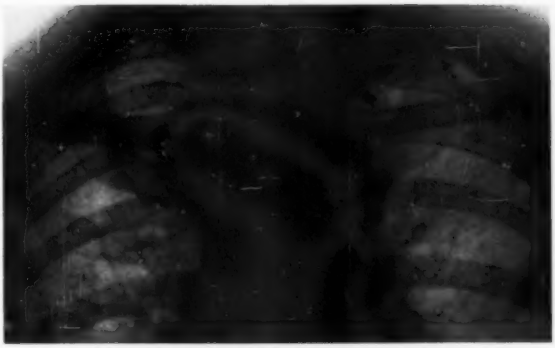


Fig. 1. Cancer apical gauche au début. Signe radiologique du »croissant» ou du »ménisque» intéressant l'arc postérieur des deux premières côtes.

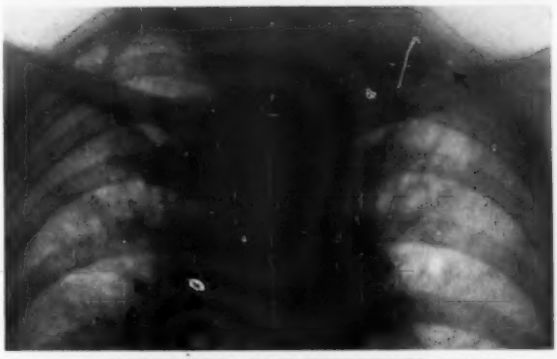


Fig. 2. Cancer apical gauche évolué au quatrième mois, le même que celui de la figure précédente. L'opacité s'est étendue à toute la région supra-claviculaire.

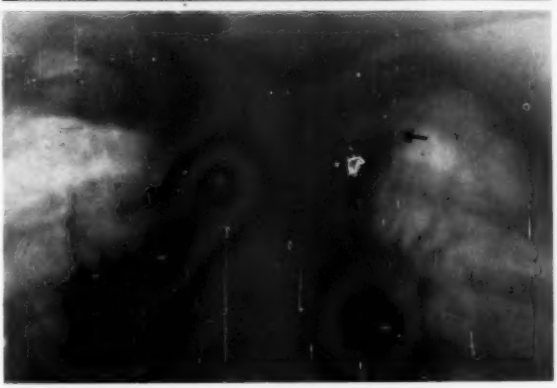


Fig. 3. Le même cas en incidence spéciale de dégagement du sommet montrant la tumeur apicale gauche. Tumeur semisphérique, évolution fatale en huit mois.

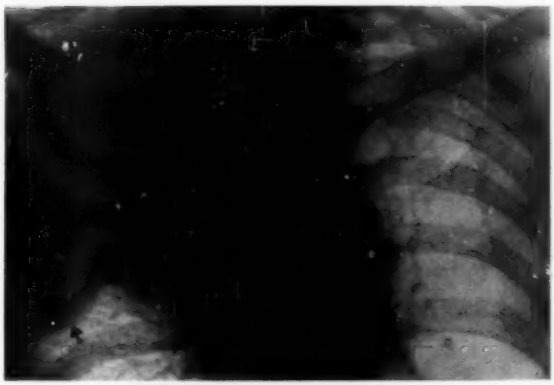


Fig. 4. Atélectasie massive du lobe supérieur droit. Cancer lobaire.

Fig. 5. Diagnostic différentiel. Opacité de la partie interne du lobe supérieur droit s'étendant à la région apicale. Lobite azygos.

Fig. 6. Diagnostic différentiel. Tuberculose avec atélectasie apicale droite. Condensation rétractile et attraction de la trachée. Bacilloscopie positive.

I. — Les incidences antéro-postérieures *obliques* sont: a) l'oblique cranio-caudale D'ALBERS-SCHOENBERG, en décubitus dorsal, la partie supérieure du thorax étant soulevée et la tête défléchie. La clacivule est ainsi rejetée vers le haut, c'est-à-dire éliminée du champ des sommets pulmonaires;

b) l'oblique caudo-craniale ou incidence inverse. Les bras étant relevés le rayon central est dirigé vers la tête suivant le plan du premier arc costal.

II. — Les incidences de *profil* sont:

a) le profil transversal, le sujet étant assis, la tête défléchie. Cette incidence permet le centrage radioscopique et fournit des renseignements sur la région apicale dans un plan latéral;

b) le profil oblique caudo-cranial, l'épaule du côté à radiographier étant abaissée et le bras du côté opposé élevé en rectitude. Cette incidence réalise un profil séparé de chacun des sommets pulmonaires.

III. — L'incidence *axiale* caudo-craniale de BARSONY, le thorax étant fortement incliné en avant, la tête fléchie à l'extrême et les bras abaissés. Le sujet fait »le dos rond». Les rayons doivent traverser une grande épaisseur de tissus et le film reste éloigné du sommet thoracique par la présence de la tête bien que celle-ci soit fléchie au maximum.

Ajoutons-y la projection *hémi-axiale* en lordose accentuée de LINDBLOM, l'auteur cherchant à situer la première côte dans un plan horizontal et obtenant ainsi un dégagement du sommet.

Nous avons eu recours à une incidence postéro-antérieure *oblique cranio-caudale* à 50°, incidence facile permettant l'adaptation à chaque cas particulier. Le sujet est debout, le tube est en position haute derrière la tête, avec rayon oblique faisant avec l'horizontale un angle d'environ 50° et atteignant la région cervicale un peu au-dessous de l'atlas. Les ombres costales se superposent au lieu de se croiser et la clavicule est rejetée vers le bas, dégageant largement le sommet des poumons.

L'examen des radiographies d'une de nos observations (fig. 1, 2, 3) montre l'intérêt de cette technique. Sur le radiogramme de face, on ne perçoit qu'une ombre supra-claviculaire décroissant vers la partie latérale externe de l'apex. L'incidence spéciale au contraire, décèle une tumeur sphérique très opaque en contact intime avec le médiastin.

VI. Traitement

Le traitement est très décevant. La chirurgie est grevée d'une lourde mortalité. La lobectomie est impossible en raison de la symphyse pleurale totale. La pneumectomie a été rarement tentée.

Il est possible d'espérer cependant qu'avec un diagnostic plus précoce,

on pourra intervenir sur des formes plus localisées laissant la plèvre de l'interlobe libre, ce qui rend l'intervention techniquement praticable.

La radiothérapie n'est qu'une méthode palliative. Dans certains cas, elle a paru écourter l'évolution fatale de la maladie. Certaines tumeurs d'origine conjonctive ou des tumeurs peu différenciées pourraient en bénéficier. Mais la sédation n'est généralement que passagère et l'on doit user de toute la gamme des analgésiques pour calmer ces malheureux malades qui continuent à accuser d'atroces souffrances.

La novocaïnisation du plexus brachial est insuffisante. Il faut envisager la radicotomie postérieure ou la cordotomie.

RÉSUMÉ

Les tumeurs étudiées dans cet article bien que de nature histologique diverse ont des caractères communs cliniques et radiologiques, qui permettent de les différencier des autres tumeurs malignes pulmonaires.

Ces signes réunis forment un syndrome que l'on retrouve dans chaque observation et que l'on peut décrire sous le nom de syndrome de Pancoast et Tobias.

L'auteur a pu identifier un total de 92 observations de ce genre, ce qui montre que le syndrome de Pancoast et Tobias n'est pas aussi exceptionnel qu'on l'a cru et qu'il doit être désormais mieux connu des médecins et des spécialistes.

L'exploration radiologique doit être menée systématiquement. Elle peut conduire à un diagnostic précoce. Le premier signe observé est l'image en »ménisque» ou en »croissant» coiffant le dôme pleural. La tomographie est d'une grande ressource pour isoler l'atélectasie de l'ombre tumorale elle-même de ses prolongements.

Le syndrome peut être incomplet suivant le siège primitif de la tumeur. Le syndrome peut être produit par des tumeurs différentes tant par leur siège que par leur nature histologique.

SUMMARY

The tumors studied by the writer, in spite of various histological appearances, show clinical and roentgenographic features in common, which may distinguish them from other malign tumors of the lung. Confining each observation, these signs determine a syndrome, that may be designed as the Pancoast-Tobias' syndrome. Totally, the writer could identify 92 cases of that sort. The Pancoast-Tobias' syndrome is not as exceptional as one used to consider it, and it should be better known from now on by physicians and specialists. Roentgenographic examination should be systematically carried out; in fact, precocious diagnosis may be obtained by roentgen rays. A horn or semilunarlike picture covering the pleural dome, is the first sign to be observed. Tomography is very helpful to isolate atelectasis from the shadow given by the tumor and its expansions. According to the initial localization of the tumor, the syndrome may not be completely demonstrable. Several tumors, different either to their localization or to their histological appearances are proved to cause that syndrome.

ZUSAMMENFASSUNG

Die in dieser Arbeit studierten Tumoren sind zwar histologisch von wechselnder Natur, zeigen aber gemeinsame klinische und röntgenologische Kennzeichen, die ihre Unterscheidung von anderen malignen Lungentumoren erlauben. Diese Symptome bilden

usammen ein Syndrom, das man bei sämtlichen Fällen wiederfindet, und das sich als Syndrom von Pancoast und Tobias beschreiben lässt. Verf. hat im ganzen 92 Beobachtungen dieser Art auffinden können, was zeigt, dass das Syndrom von Pancoast und Tobias nicht so selten vorkommt, wie man geglaubt hat, und dass es in Zukunft den Ärzten und Spezialisten besser bekant werden muss. Die röntgenologische Untersuchung muss systematisch vorgenommen werden. Sie kann eine Frühdiagnose ermöglichen. Das erste beobachtete Zeichen ist eine Scheiben- oder halbmondförmige Bildung, die der Pleurakuppel aufsitzt. Die Schichtaufnahme ist von grosser Bedeutung um zwischen Telektase und Tumorschatten mit seinen Ausläufern zu unterscheiden. Je nach dem verschiedenen primären Sitz des Tumors kann das Syndrom unvollständig sein. Das Syndrom kann durch sowohl inbezug auf ihren Sitz als auch auf ihren histologischen Bau verschiedenartige Tumoren erzeugt werden.

BIBLIOGRAPHIE

1. Blanchard (J) et Lecoeur (J). — Semaine des Hôpitaux de Paris, mai 1943, 118.
2. Dahm (M). — Fortschr. a. d. Geb. d. Röntg., Leipzig, 58 n° 6, décembre 1938, p. 536—546.
3. Duvoir (M), Poumeau-Delille (G), Audoly (P) et Hadengue (A). — Bull. et. Mém. Soc. Méd. des Hôp. de Paris, 3ème s., 59ème an., n° 25—27, 9 juil. 1943, 365—366.
4. Mahoudeau (D) et Courjaret (J). — Sem. des Hôp. de Paris, 21ème an., n° 42, 14 nov. 1945, 1196—1199.
5. Mathey-Cornat (R). — Journ. de Radiol., Paris, t. 26, n° 9—10, 1944—1945, 309—311.
6. Michon (P), Herbeuval (R) et Faivre (G). — Bull. et Mém. Soc. Méd. des Hôpitaux de Paris, 4ème s., oct.—nov. 1945, n° 26—31, 1945, 394—396.
7. Pancoast (H. K.). — The Journ. of the Amer. Med. Ass., 90, n° 17, 22 oct. 1932, 1311.
8. Pruvost (P) et Teyssier (L). — Bull. et Mém. Soc. Méd. des Hôpitaux de Paris, 3ème s., 59ème année, n° 13—14, 9 avril 1943, n° 163—166.
9. Stein (J. J.). — Journ. Amer. Med. Ass., Chicago, III, n° 18, 29 oct. 1938, 1612—1617.
10. Teyssier (L) — Thèse de Paris 1942, Arnette Imprim.
11. Tobias (J. W.). Thèse de Buenos-Aires 1931; La Semana Med. 28 mai 1931, p. 1479; Rev. de la Ass. med. Argentina, 30 oct. 1937, 155—157.

FROM THE SAMARITEN CHILDREN'S HOSPITAL, STOCKHOLM (HEAD: PROF. E. MALMBERG)

HEMOSIDEROSIS OF THE LUNGS — TYPICAL ROENTGENOLOGICAL FINDINGS[1]

by

Olle Elgenmark and *Sven Roland Kjellberg*

During the years 1944 to 1946 a patient suffering from hemosiderosis of the lungs has been treated repeatedly at the Samariten Children's Hospital. As only a few cases of this disease have been previously reported we consider it of value to publish further details regarding the syndrome, since this is, as a rule, so typical that there should be no difficulty in diagnosing the condition if only one keeps one's eyes open for it.

Case report. The father, mother, and two other children in the family were healthy. The patient was a girl, a native of Estonia, born in 1938. Parturition had been normal. Weight at birth normal. Even at birth she had had cyanotic hands and feet, but there were no other circulatory disturbances. She cut her teeth, and began to sit up, stand, and walk at the normal time. She was healthy during the first year of life. It was only, at 2—3 years of age, when she began to move about more actively, that it was observed that she got breathless easily, but in spite of this she was not particularly affected. At the age of 3—4 years on moderately active movement her breathing difficulties increased, and her lips became cyanosed. She sometimes had a cough, with a little colourless sputum, and in connection with these periods she ran a slight temperature. She complained nearly every day of a headache and abdominal pains, and she often vomited. In the spring of 1944 she was examined by an Estonian physician, who, on the basis of the roentgen findings, diagnosed advanced pulmonary tuberculosis. The child came to Sweden the same spring as a refugee, and at the examination by miniature radiography carried out at that time the only finding was enlarged hilar glands. Her general condition was fairly good at first, but in the summer of 1944 a deterioration took place, with severe breathlessness on effort, increasingly severe cyanosis and cough without sputum, and a low fever around 38° C. She was admitted to the Samariten Children's Hospital on the suspicion of acute bronchopneumonia.

Physical examination revealed a girl with a thin body, small and delicately built for her age. There was no dyspnea when she was at rest, but she became breathless on the slightest exertion. There was deep cyanosis of the lips, hands and feet, especially the outer phalanges, which had a drumstick appearance. The general condition was nevertheless surprisingly unaffected. Temperature, 38° C; pulse, 100/min.; respiration rate, 22/min. Blood pressure, 105/60. Heart normal. *Lungs.* Slight dullness basally in both pulmonary fields and somewhat weakened vesicular respiration. A few dry and

[1] Submitted for publication, May 3, 1947.

moist râles. The tactile fremitus was the same on both sides. Liver and spleen not palpable. Roentgenograms of the skeleton were normal. Blood picture: Hemoglobin 96 per cent, red blood cells 4.6 mill., whites 6,400. Platelets 380,000. Differential count: Staff cells 1 per cent, segmented cells 55 per cent, eosinophils 10 per cent, lymphocytes 32 per cent, monocytes 2 per cent. Sedimentation rate, 20 mm/hr. Tuberculin test: Negative reaction to 1 mg. Mantoux. Urine normal. The roentgen findings from the lungs will be discussed further on, in another connection.

Her general condition showed considerable improvement during her stay in the hospital, though the only treatment was sedatives. She was discharged after a stay of 3 days.

After a while her health again deteriorated, and she spent three different periods in hospital during 1945. She was suffering each time from a considerable degree of dyspnea, a severe cough, and fever. On the other hand, in the intervening periods, she was practically without discomfort except for the dyspnea. Blood counts made at each hospital stay revealed no particularly severe anemia. Only during one period was the hemoglobin value 70 per cent and the red blood count 3.4 mill.; at the other observations the hemoglobin values registered were around 100 per cent and the red cell count in the neighbourhood of 5 million. The differential count showed consistently an eosinophilia of about 10 per cent.

During her last stay at the hospital in May 1945, the patient coughed up pale yellow, slightly blood-tinged sputum. Staining with 2 per cent potassium ferrocyanide revealed numerous grains of hemosiderin in the cells in the sputum.

Subsequent to her last period in hospital her health began to improve noticeably. She gained in weight and grew taller. Her breathing difficulties and cough almost entirely vanished and she has been able to lead a fairly active life without suffering discomfort. The peripheral cyanosis also subsided. At an examination at the outpatient department the drumstick appearance of the fingers and toes were seen to have almost completely disappeared. Auscultation of the lungs yielded normal findings. She was going to school and was doing well at her lessons.

The roentgenograms of the lungs showed changes varying in severity with the clinical course of the disease. The accompanying roentgen pictures illustrate the situation as regards the lungs at three different examinations.

Apparently the first to describe this disease was CEELENS, who, in 1921, published an account of two cases of brown induration which was not due to heart disease. Accordingly this form was called essential or idiopathic induration. Since then, similar cases have been reported by GELLERSTEDT (1939), ANSPACH (1939), GLANZMAN and WALTHARD (1941), WALDENSTRÖM (1940 and 1944), and SELANDER (1944). Both WALDENSTRÖM and SELANDER have surveyed the earlier cases in some detail and we therefore refrain from repeating the relevant facts here.

From the literature, it is evident that the leading signs and symptoms are cyanosis and dyspnea, which usually appear soon after birth or during the first few years of life. In a few cases. however, these symptoms appear at a later stage. In some they only occur after exertion. Most patients have a fairly bad cough with sputum, which may be blood-tinged and contain hemosiderin pigment (demonstrable by staining with 2 per cent potassium ferrocyanide). As a rule, the clinical picture

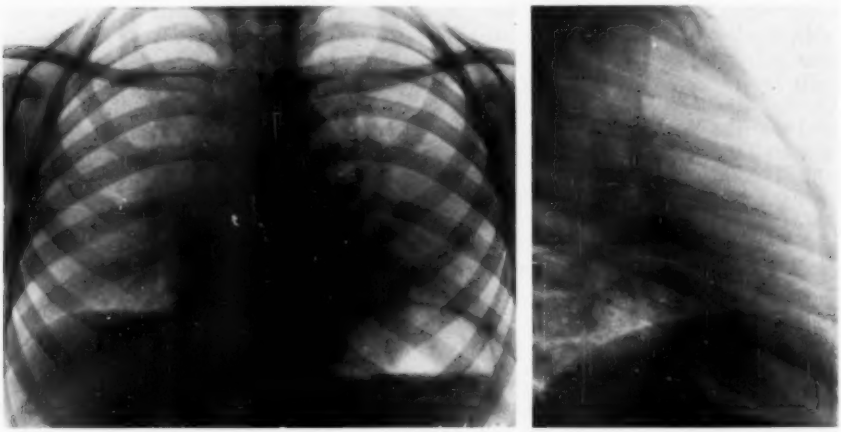


Fig. 1. June 26, 1944. The picture is characterized by diffuse mottling, of a mossy appearance, particularly in the centre of the two pulmonary fields. Moderate hilar gland enlargement is apparent on both sides.

Fig. 2. Feb. 2, 1945. The mossy mottling has become more extensive in both pulmonary fields.

is also characterized by anemia of the secondary type which can be influenced by the administration of iron and by rest, eosinophilia between 5 and 10 per cent, and, in some instances, a moderate degree of leukopenia. The temperature and erythrocyte sedimentation rate are usually slightly elevated, but the pulse is normal. As a rule, the clinical examination yields no positive findings from the internal organs with the exception of a certain dullness over the pulmonary fields, which

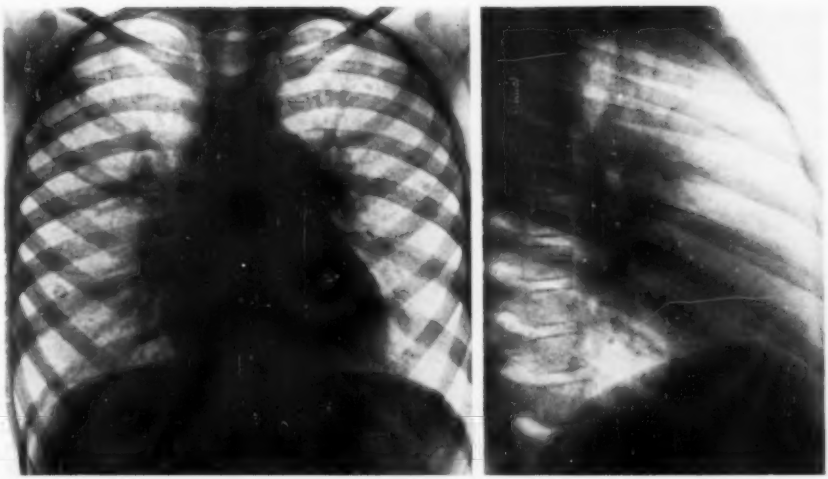


Fig. 3. Sept. 13, 1946. Both the pulmonary fields have cleared up considerably.

varies in intensity in proportion to the extent of the process, respiratory sounds somewhat harsher than normal, and râles.

The roentgen appearance of the lungs is so characteristic that pulmonary hemosiderosis can be diagnosed solely on the grounds of these findings in practically every case. No other disease produces at this age a roentgen picture showing diffuse shadows of increased density, scattered more or less all over both pulmonary fields and absolutely independent of the borders of the lobes, in some cases with a tendency to become denser towards the bases. This cloudiness, however, often alternates with mottling of a mossy appearance. In the early stages of the disease, as well as in the remissions, the mottling is the dominating feature. Another roentgenologic finding is enlarged and deepened hilar shadows. Not infrequently, the changes in the roentgenogram follow the course of the disease. The explanation of these roentgen findings is that the alveoli have become more of less filled with iron pigment, thus reducing the air content of the lungs.

The treatment of the disease is entirely symptomatic. Roborants and iron not infrequently produce a temporary improvement. The prognosis is bad and from what can be ascertained from the literature the disease always leads to death, in spite of the occurrence of remissions of varying duration.

The disease has usually been referred to as the CEELEN-GELLERSTEDT disease or syndrome, because it has previously chiefly been of interest

to histo-pathologists. The latter have described the histologic appearances in some detail. As, however, a characteristic clinical and roentgenologic picture has taken shape during the past few years, we consider the name suggested by WALDENSTRÖM, hemosiderosis of the lungs, to be more adequate, as it expresses the nature of the process, an internal hemorrhage into the lungs with hemosiderin formation.

Judging by the literature, the disease seems to be a much commoner occurrence among women than men. Of the 12 cases previously described, 4 were of the male and 8 of the female sex. The explanation of this has not yet been found. WALDENSTRÖM, however, suggests in his article written in 1944, that the disease may be closely related to, or arise from sideropenic anemia. If this theory is correct the distribution on the two sexes could be explained, since sideropenic anemia is much commoner among women than among men.

Although our patient is at present free from all subjective symptoms, and yields only insignificant objective findings, yet the prognosis is bad, according to what can be ascertained from similar cases reported. Despite periods of almost perfect health all patients have died from their disease.

SUMMARY

The authors describe the typical roentgen aspect of hemosiderosis of the lungs and report a case of the disease.

ZUSAMMENFASSUNG

Verff. beschreiben das typische Bild der Hämosiderosis pulmonum und berichten über die bei einem Falle erhobenen Befunde.

RÉSUMÉ

Les auteurs décrivent l'image radiologique caractéristique de l'hémosidérose pulmonaire, et relatent un cas de cette affection.

REFERENCES

ANSPACH, W.: Amer. J. Roentgen. 41: 592, 1939.
CEELEN: Henke Lubarsch Handb. der spez. Path. Anatomie, Bd 111, 1931.
DUKEN: Erg. inn. Med. u. Khk. 39: 446, 1931.
GELLERSTEDT: Acta patholog. et microb. Scand. 16: 386, 1939.
GLANZMANN u. WALTHARD: Mschr. f. Kinderheilk. 1941.
KERLEY: Recent Advances Radiol., London 1936.
SCOTT, SCOTT PARK and LENDRUM: Brit. Journ. of Radiol. XX: 100, 1947.
SELANDER: Acta Paediatr. 31: 286, 1944.
WALDENSTRÖM: Nord. Med. 6: 940, 1940.
—, Acta Radiol. 25: 149, 1944.

FROM THE ROENTGEN DEPARTMENT OF HALMSTAD HOSPITAL (HEAD: BENGT LILJA, M. D.),
AND THE ROENTGEN INSTITUTE OF SERAFIMER HOSPITAL
(HEAD: PROFESSOR ERIK LYSHOLM, M. D.)

CHRONIC MASTOIDITIS AND ITS ROENTGEN PICTURE[1]

by

Marcus Diamant, M. D., and *Bengt Lilja*, M. D.

The textbooks tell us that chronic otitis arises either from an acute otitis or that it appears as a chronic insidious process from the outset. There is no evidence to show how often the disease has developed in the one or the other way. Opinions differ both about the causes of chronic otitis and the problem of cholesteatoma.

Up to the end of the last century it was believed that a chronic otitis caused a diminuation of a previously well-developed cell system. At the beginning of the present century, however, it became evident that cell systems of different sizes occur normally and that small cell systems easily become the seat of chronic otitis. At the same time the general opinion was that acute otitis arose in connection with large cell systems. In 1940, DIAMANT investigated the size of the cell system by making planimetric measurements on roentgen pictures taken partly in normal material and partly in cases of acute and chronic otitis. This has enabled us to determine the average values for the size of the cell system in the different groups and the variability within them. On an average the largest cell systems are encountered in normal material, the smaller ones in the acute otites and the smallest of all in the chronic otites. Furthermore the cell system in chronic otitis with marginal tympanic perforation is somewhat smaller than in cases with central perforation. DIAMANT has shown statistically that the earlier conception that chronic otitis readily arises in ears with small cell systems is correct and, moreover, has established the fact that chronic otitis practically never occurs when the size of the cell system exceeds the mean value for normal ears. Further it is also proved by DIAMANT that acute otitis occurs more frequently in connection with small cell systems. The earlier conception that acute otitis was more common in subjects with

[1] Submitted for publication, Dec. 14, 1946.

large cell systems arose from comparisons made between the acute and the cronic otitis material; the normal material was not taken into consideration.

It is therefore obvious that the occurence of otitis and its clinical course is connected in some way with the size of the cell system. This connection has been made the subject of various speculations. The most generally accepted point of view has earlier been WITTMAACK's opinion (1918) that otitis, appearing at an early age, sometimes gives rise to such changes in the mucous membrane that it later causes partly an inhibition in various degrees of the development of the cell system and partly a predisposition to chronic otitis. SCHWARZ (1929) and ALBRECHT (1931) disagree with WITTMAACK and assert that this supposed property of the mucous membrane is not released by an early otitis, but is rather conditioned by hereditary factors. There seems, however, to be no possibilities of urging that *the mucous membrane* directs the development of the cell system, neither that, by virtue of any special properties, *the mucous membrane* gives any predisposition to chronic otitis, as this cannot be proved. In an investigation of families and of double and single egg twins, DAHLBERG and DIAMANT (1945), by making planimetric measurements on roentgen pictures, have been able to show statistically that hereditary factors play the biggest part in regard to *the size* of the cell system. The same must then apply to the occurrence of chronic otitis as so strong a connection is shown between small cell systems and chronic otitis.

According to the textbooks, the clinical concept »chronic otitis» seems to imply a symptomatic diagnosis which is dominated by perforation of the tympanic membrane remaining for a certain period accompanied, periodically at all events, by discharge from the middle ear. Chronic otitis here constitutes a collective concept in which the position of the tympanic perforation and the cause of the discharge from the ear are not considered. The condition may be one of a chronic otitis with marginal tympanic perforation and osteitis, possibly associated with a cholesteatoma, a state that one might regard as being a »genuine» chronic otitis. But clinically one also regards as chronic otitis, a central tympanic perforation with discharge from the ear that is maintained by adenoid vegetations, sinuitis or, for that matter, by any source of infections in the cavities with which the middle ear has direct connection. If this source of infection is eliminated, the discharge ceases. That we are merely dealing here with a »consecutive» chronic otitis shows that the terminology has not followed the development of our knowledge of »chronic otitis».

The cell system in the temporal bone also belongs to the annexal regions of the middle ear. It is a common observation that a progres-

sive acute infection in this cell system maintains an *acute* otitis with discharge from the middle ear, preventing the healing of the latter and, in some cases, causing an acute destructive mastoiditis with its clinical picture. It is also well known that the cell system can also constitute a source of infection that maintains a *chronic* otitis, but, in many cases, it is not possible to establish this without the help of roentgen pictures because the other signs of mastoiditis are non-existent or difficult to interpret. In a number of cases it seems that even an infection can remain and progress in the cell system, despite the fact that the middle ear and the tympanic membrane show completely normal conditions. *The condition, with a permanent indolent infection in the cell system, is often followed by productive osteitic changes with osseous accretions on the cell walls that are demonstrable on roentgen examination (of which more below), and, in the following, is referred to as chronic mastoiditis.*

With improved technical aids and a wider experience of the many pictures difficult to interpret, the roentgen examination of cases of otitis has become increasingly important in clinical practice. In this way one can get to know the size of the cell system and its extent in different anatomical directions. In many cases one can obtain valuable information for diagnosis by observing the nature of the cell walls, the osteitic changes and the osseous destructions. It would seem, however, especially in cases of chronic mastoiditis, that the adequate conclusions which the pictures allow concerning the nature of the pathological process have not yet been reached. This paper is intended as a contribution to our knowledge of chronic mastoiditis. Certain roentgen signs will be demonstrated that have not been exploited and assessed.

The processes of ossification in the ear are already known. Apposition of newly formed bone in the cell system under the influence of an infection has been histologically demonstrated by several authors, amongst others by Goerke in 1905. In 1936, Ziegler and in 1938, Rainer also have shown the occurrence of osseous accretions as well as more fungoid irregular proliferations of newly formed bone on cell septa, whereby single cell lumina have become obstructed.

E. G. Mayer (1930) has discussed the question of the healing of acute mastoiditis. In cases in which a restitutio ad integrum has not arisen, Mayer has observed, by roentgenologically following the development of the process in individual cases, an increased denseness on the picture which he considers to be due to ossification in the tissue that fills the cells. He states: »Diese dichte Verschattung ist ein charakteristisches Zeichen reparativer Vorgänge.» An obstruction of the cell lumina is the result. From his account of the matter, however,

it does not appear possible to distinguish on the roentgen picture any such reparatory process from a preformed cell formation with thick cell walls. On the contrary, the author writes: »Auch die unscharfe Begrenzung solcher Hohlräume lässt keinen Schluss auf einen akut entzündlichen Prozess zu, da sich eine solche auch bei manchen Pneumatisationstypen findet.» E. G. Mayer has touched upon the problem but, in many respects, his account is misleading. Similar discoveries with partial ossification during the course of a mastoiditis have been made by W. Meyer (1932), who states that only the larger cells have been replaced by bone formation, while the periantral cells show a normal appearance even after infection. Mittermaier (1940) has interested himself in the question of ossification in cases of mastoiditis. He asserts that on proliferation the bone may become either spongy or sclerotic, and that the difference between these can only be established histologically. Mittermaier has also had an opportunity of following roentgenologically two cases of mastoiditis. In one of them there was a recurrence of pneumatization which had previously disappeared so that a re-pneumatization, in all probability with spongy bone, has occurred. In the other case the pneumatization gradually disappeared to a great extent instead, and was replaced by bone structure; and it was only the repeated photographing that revealed the true nature of the process as being due to a chronic infection. The same author has published the report of another case which is described as being an uncommon discovery wherein one single photograph is considered sufficient to make the diagnosis, chronic infection in the cell system with circular apposition of bone around the cells and obstruction of the cell lumina. These pictures show small cells with broad, dense bony trabeculae.

It has been shown that, in the routine work in a roentgen department, one occasionally comes across cases of chronic mastoiditis with signs of reactive ossification in the cell system. The feature in common with the cases described below is precisely the occurrence of such ossification.

The outstanding feature common to the roentgen pictures in cases of chronic mastoiditis is that the cell trabeculae have a peculiar appearance. The cell walls are thick and show uneven contours towards the lumen which give a characteristic impression of roughness. As a rule these thick bone trabeculae include small cells or different sized ones. Owing to the thickness of the cell trabeculae, the cells are more widely dispersed than usual. Between these typical parts one sometimes finds destroyed areas containing defective bone trabeculae whereby abnormal cavitations have arisen in the bone bounded by the ragged, thickened and rough bone trabeculae.

On the basis of the roentgen discoveries it would seem justifiable to classify these cases in a special group which, as will be seen from the following, is also supported by the discoveries made during the operation and the patho-histological picture. On the other hand the clinical picture shows considerable variations.

The authors have noticed these cases in their practice for several years and they have not been uncommon. We will now give a report of nine typical cases: our material contains many similar ones. We have selected these cases in order to show differences in the clinical picture. They have all been examined in the roentgen department of Halmstad Hospital, the majority by Lilja, and all, with the exception of one, were operated on by Diamant. Four cases have been patho-histologically examined at the Pathological Institute in Lund, three by Ahlström and one by Sjövall.

Casuistics

(1) G. F. S., Male. Aet. 34 years. *Summary.* The patient's left ear was trepanned in 1915 at the age of 5. Otitic relapses in 1935 and 1936 and an abscess in the scar in 1942. A fresh otitic relapse lasting for four months in 1944. Roentgen examination in 1936 showed a considerable cell system (incompletely trepanned or newly formed after trepanation). A chronic mastoiditis was demonstrated with a progressive thickening of the bone trabeculae and increased density of the bone from 1936—1944. Trepanation in 1944 showed dispersed cells with pathological content in solid bone tissue as well as a caseation of the cell walls around the antrum. Larger and smaller cavitations which were covered in many places by a bony tissue, obviously newer than the surrounding bone, were found in the histological preparation.

Extracts from case record. After trepanation of the left ear in 1915, the patient was free of symptoms until 1935. A paracentesis was then performed for otitic trouble accompanied with earache after which the patient was once more relieved. On 3. 2. 36 the patient once again sought medical attention for earache and was relieved after a fresh paracentesis.

Roentgen examination for the first time on 14. 2. 36. Fig. 1. Left ear. Slight operative defect. A large number of cells remained in the base of the pyramid, the majority small, especially around the antrum. There were larger cells in the root of the zygomaticus as well as in the lower part of the squama. The cell system in the base of the pyramid was cloudy with thickened cell walls.

In 1942 an abscess appeared in the scar but it healed rather quickly after incision. Slight ear symptoms in 1943.

On 17. 7. 44 the patient again sought medical attention for earache and signs of salpingo-tympanitis. On 25. 7 the tympanum was coated and on 21. 8 there were signs of otitis so parecentesis was performed. Sedimentation rate 10 mm.

As the ear was still discharging on 16. 10, the patient was advised to submit to re-operation. This, however, was postponed.

Roentgen examination on 13. 11. 44. Fig. 3. Left ear. The cell structure around the operative defect, the antrum and in the upper part of the mastoid process was, to a large extent, replaced by thick, rough bone trabeculae which surrounded the small irregular cells. Consequently there were signs of chronic mastoiditis with progressive ossification and reduction in size of the cell cavities.

Operation on 18. 11. 44. Trepanation. Corticalis externa at least 1 cm thick after which one encountered dispersed cells with solid bone in the surroundings. The cells were filled with grey, gelatinously thickened mucous membrane. Pronounced caseation of the remaining thinner cell walls around the antrum. Some cells about the size of a pea with granulating mucous membrane in zygomaticus. In the base of the zygomatic process the dura was exposed in one place, with somewhat roughened surface.

Histology. Pathol. Inst. Lund. No. 6612/1944. The chiselled off part of bone from the corticalis externa and around the antrum was built up histologically of an almost compact bony tissue. Dispersed within this one could see round or oval, as a rule small but sometimes larger and somewhat irregular spaces filled with a loose, vessel-bearing connective tissue. Many of these cavities were surrounded by bone tissue, decidedly younger than the neighbouring bone and sometimes covered by a number of osteoblasts. It is conceivable, however, that the larger ones among them constituted old cells whose lumina had been filled up with granulation tissue and whose walls showed a reactive laying down of bone.

In the chiselled off fragments from the periantral cell region one could see a cell system with chronic inflammatory changes. The mucous membrane was swollen and permeated with a rather large number of round-cell infiltrations. Many of the bone trabeculae showed signs of lacunar resorption. One fragment showed the picture of a chronic suppurative inflammation with a tendency to necrotic disintegration. No evidence of tuberculous infection.

Diagnosis: Chronic mastoiditis (AHLSTRÖM).

(2). A. P. Female. Aet. 3 years. *Summary.* This is a case of a roentgenologically demonstrated chronic mastoiditis with signs of ossification following a discharge from the ear occurring in connection with scarlatina and lasting for nearly three months. On trepanation, hard thick bone trabeculae were found with slight destruction around the antrum. Histology showed the occurrence of newly formed bone in the cell walls.

Extracts from case record: The patient was brought for medical attention on 1. 10. 44 for a discharge from the ear which had begun on 28. 9 following an acute onset of the illness. A perforation of the tympanum in the posterior lower quadrant was found. A typical scarlatina desquamation manifested itself after some weeks.

Roentgen examination on 14. 10. 44. Fig. 4. Left ear. Cell system with distribution in periantral triangle. The cells were small and diffusely condensed. No signs of bone destruction.

Owing to a progressive secretion from the ear and a persistent tympanic change with sticky coating without visible perforation, a roentgen examination was taken again on 15. 12. 44. Fig. 5. Left ear. Marked cloudiness over the cell system as before but, in addition to this, the bone trabeculae between the cells had increased in density and breadth and now showed rough, uneven contours. The earlier small-cell cavities had become still smaller. No destruction could be seen. Thus there were signs of an ossiform deposit in the bone trabeculae resembling the picture of a chronic mastoiditis.

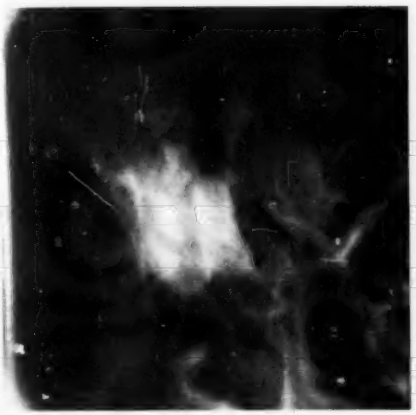


Fig. 1.

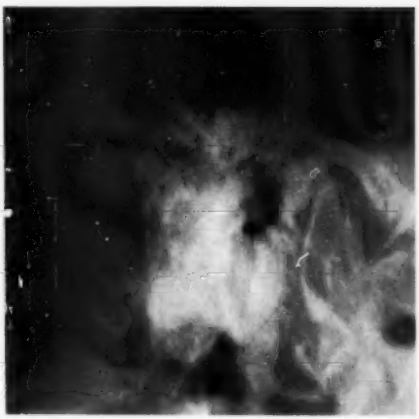


Fig. 3.

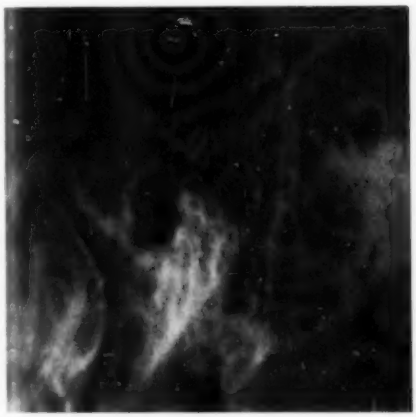


Fig. 2.

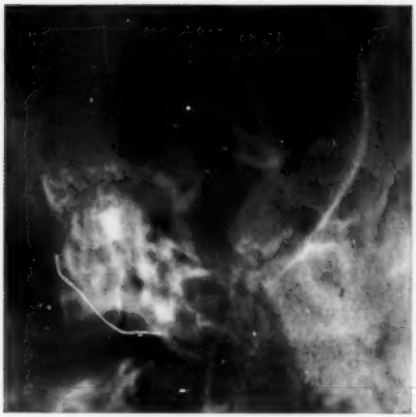
Fig. 1. Case 1. Left ear. Small operative defect. In the base of the pyramid, especially around the antrum, a considerable pneumatization with thick cell walls. In the zygomatic root and also in the lower part of squama temporalis there are larger cells.

Fig. 2. Case 1. Right ear. Normal roentgen finding. Picture for comparison.

Fig. 3. Case 1. Left ear. The cell structure consists of thick and rough bony trabeculae surrounding the small, irregular cells. Chronic mastoiditis with progressive formation of new bone.

Operation on 19. 12. 44. Trepanation. The cell trabeculae were remarkably hard and the cells were filled in the central parts with sticky granulations. Slight destruction around the antrum with thick suppuration.

Histological report. Pathol. Inst. Lund No. 7287/1944. The scraped out portions of tissue from the left ear show a cell system with, as a rule, a much thickened mucous membrane in which large numbers of lymphocytes, plasma cells and a few leucocytes are dispersed. The leucocytic infiltration is more pronounced in certain parts; there is also an admixture of eosinophile elements. The lumina of the cell cavities are greatly reduced by the thickening of the mucous membrane. The bone trabeculae are noticeably



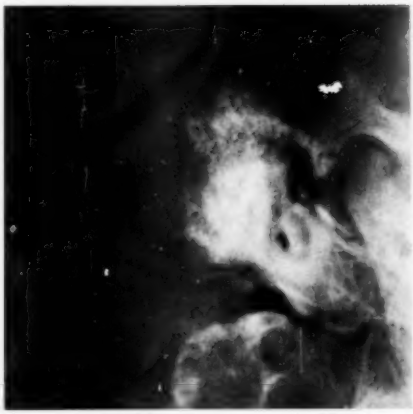


Fig. 4. Fig. 5.

Fig. 4. Case 2. Left ear. Cell system with small cells, diffusely cloudy.

Fig. 5. Case 2. Left ear. The bony trabeculae between the cell cavities show increased density and breadth and rough uneven contours. The previously small cell cavities have become still smaller. No visible destruction. Chronic mastoiditis with signs of formation of new bone.

thick and bulky. They are built up partly of old bone of thoroughly mature structure and partly of newer bone which here and there, however, is slightly osteoid in character. As a rule the bone trabeculae are covered by rows of osteoblasts and show round bone corpuscles without the regular arrangement generally found in the old bone. The newly formed bone, however, certainly has a calcium density and an age that make it roentgenologically observable.

Diagnosis: Chronic mastoiditis (AHLSTRÖM).

(3) A. Å. Male. Aet. 43 years. *Summary.* Clinically, the case coincides well with an acute otitis with mastoiditis which, owing to the patient's neglect was operated on first after a lapse of 4 months. Roentgen shows chronic mastoiditis which is confirmed by trepanation and histological examination. The latter shows indications of the occurrence of newly formed bone in the form of thinner or thicker deposits.

Extracts from the case record: The patient sought medical attention on 20. 9. 43 for discharge from the left ear 10 days after the onset of the earache. Paracentesis. The patient failed to appear for treatment but returned 3 months later, on 30. 12. The discharge had continued the whole time. Examination showed a swollen, reddened tympanum with secretion in the auditory meatus. No visible perforation. Sedimentation rate 6 mm/1 hr.

Roentgen examination 30. 12. 43. Fig. 6. Left ear: Cell system with rather limited distribution. On this side the cell trabeculae did not show distinct contours everywhere

Fig. 6.

Fig. 7.

Fig. 6. Case 3. Left ear. The cell structure is partially defective. In several places intermediate intact cell trabeculae are thick, with uneven contours. Chronic mastoiditis with destructive and productive changes.
Fig. 7. Case 3. Right ear. Normal roentgen finding. Picture for comparison.

and the structure was partly confused and defective. The intermediate remaining cell trabeculae were thickened and irregular in several places. The roentgen findings show the picture of a chronic mastoiditis with destruction.

Operation on 10. 1. 44. Trepanation. Rather thick corticalis externa and thick cell walls everywhere. The cell system was rather small with dispersed cells of various sizes filled with turbid fluid and thickened mucous membrane.

Histological report. Pathol. Inst. Lund. No. 134/1944. The preparation consisted of a compact lamellar bone with Haver's canals and contained small and medium-sized cells. These were covered by a granulation tissue that was, for the most part, low and poor in cells but which, in a number of places, showed considerable, cushion-like thickenings with dense round-cell infiltrations. Within these one could see here and there irregularly shaped foci of cells richer in protoplasm of a granular nature (no giant cells, no necrosis; phagocytosis?). There were signs of previous resorption of the compact bone around these cells and, on the garland-shaped border of the compact bone, there were thinner or thicker deposits of newly formed bone. Leucocytic infiltration was nowhere observable; the mastoid cells were empty.

Diagnosis: Chronic mastoiditis (SJÖVALL).

(4) J. A. N., Male. Aet. 64 years. *Summary.* A patient with a normal tympanum, who has never had a discharge from the ear, complains of buzzing and a feeling of deafness in the left ear and, during the period preceeding the operation, of aching round the ear as well. Roentgen examination showed a chronic mastoiditis with destruction. Trepanation verified the roentgen findings and explained the pains experienced by the patient.

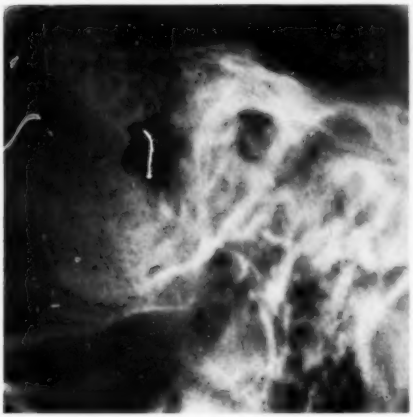


Fig. 8.

Fig. 9.

Fig. 8. Case 4. Left ear. The cell trabeculae are in several places thick with rough contours. In the basal part of the mastoid process a destruction almost the size of an almond. Chronic mastoiditis with productive and destructive changes.
Fig. 9. Case 4. Right ear. Normal roentgen finding. Picture for comparison.

Extracts from the case record: The patient sought medical attention on 17. 1. 41 for buzzing sounds in the ear which had lasted for three months, as well as a feeling of deafness in the left ear which he had experienced during the last few days. Had never had discharge from the ear. Both tympana were found to be quite normal. Catheterization was performed five times during the following three months but there was no improvement.

Roentgen examination on 7. 4. 41. Left ear: The cell system was rather smaller than that on the other side. The cell trabeculae appeared somewhat irregularly thickened but, on the other hand, could not be differentiated everywhere. The discoveries resembled a chronic mastoiditis.

As there was no relief, another roentgen picture was taken on 5. 5. 41. Left ear as before. Still a rarification of the cell structure in the basal part of the mastoid process.

One month later there was still no transudate in the middle ear.

When the patient was examined on 23. 10. 41 the patient complained of an ache around the left ear.

Roentgen examination on 23. 10. 41. Fig. 8. Left ear. The cell trabeculae as before. A defective structure, covering an area almost the size of an almond, but more pronounced than ever, was observed in the basal part of the mastoid process. The roentgen findings coincided well with the picture of a chronic mastoiditis with partial destruction.

Owing to the discomfort which the patient complained of and particularly on account of the roentgen fidings, an *operation* was performed on 27. 10. 41. Trepanation: The cell system was less than medium sized, with thick corticalis externa. An area about the size of an almond around and below the antrum showed caseous cell walls with discoloured fluid in the cells.

(5) K. N., Male. Aet. 29 years. *Summary.* As a child the patient had been troubled at times with earache and discharge from the left

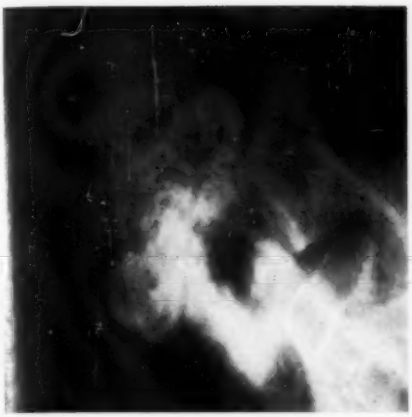


Fig. 10.

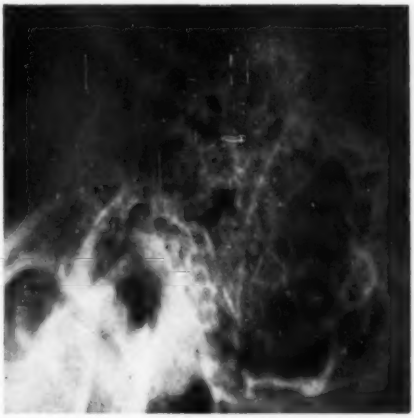


Fig. 11.

Fig. 10. Case 5. Left ear. Thick septa between the small cell cavities and rough contours towards the lumina. No certain destruction visible. Chronic and productive mastoiditis.

Fig. 11. Case 5. Right ear. Normal roentgen finding. Picture for comparison.

ear. In the spring of 1938 he had discharge again which lasted for a short time. Clinical examination showed a pale, indrawn scar. The roentgen picture showed signs of chronic mastoiditis which was confirmed by the trepanation when a caseous cell system was also found around the antrum.

Extracts from case record: The patient sought medical attention on 3. 11. 38. Between the age of 6 and 7 he sometimes suffered from a recurring ache with discharge from the left ear, after which time he was free from subjective ear trouble. In May 1938 he again had discharge from his left ear. Dry in June after syringing but he was sometimes troubled with earache and impaired hearing on the left side. The tympanum showed pale, indrawn scar in the region of the antrum. No secretion. Sedimentation rate 7 mm/1 hr.

Roentgen examination on 3. 11. 38. Fig. 10. Left ear. Cell system less than medium sized. The cell trabeculae thickened. No sign of destruction.

Operation on 12. 11. 38. Trepanation. The cell system medium sized with relatively few cells. The cells were of various sizes with thick, hard dividing walls. Around the antrum and below the labyrinth the cell system was caseous. In a number of places the cells were filled with a putty-like substance.

(6) K. G. K., Male. Aet. 47 years. *Summary.* After discharge from the left ear many years ago, the patient had a recurrence of the discharge and earache; an examination, some days later, showed polyp and central perforation. The roentgen picture gave the usual

Fig. 12.

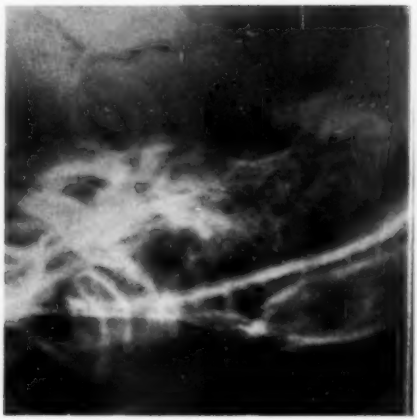


Fig. 13.

Fig. 12. Case 6. Left ear. The cell walls are thick with uneven contours and the cell cavities small. No certain destruction. Chronic mastoiditis with mainly productive changes.

Fig. 13. Case 6. Right ear. Normal roentgen finding. Picture for comparison.

picture of chronic mastoiditis. The diagnosis was confirmed by trepanation.

Extracts from the case record: The patient sought medical attention on 18. 3. 39. Suffered from earache as a child. Discharge from left ear in 1938 ceased after a relatively short time. The patient had now got earache in the left ear with, during the last few days, discharge. A large polyp was found which filled the auditory meatus and after its removal there was a small central perforation. Hearing very much impaired. At the same time he had acute pansinusitis which healed after syringing for four days. During this time the polyp recurred in the auditory meatus. Sedimentation rate 50 mm/1 hr.

Roentgen examination on 21. 3. 39. Fig. 12. Left ear. Medium sized cell system. The trabeculae were partly rather indistinct but partly also thickened and broadened. On the whole, however, the structure was intact and without definite destruction. The roentgen disclosures were considered to coincide more with a chronic mastoiditis.

Operation on 24. 3. 39. Trepanation. The cell system less than medium sized. The cells were of irregular size, contained thickened mucous membrane and, in several places, a yellowish-grey, suppurating secretion. The mucous membrane in the antrum was thick and granulating and, over a small area, the corticalis interna was destroyed, exposing the dura.

(7) R. V. S., Male. Aet. 21 years. *Summary.* After previous discharge from the ear, a marginal perforation together with a cholesteatoma was observed. The roentgen picture showed various large, cell-like cavities with irregularly thickened walls similar to the pictur

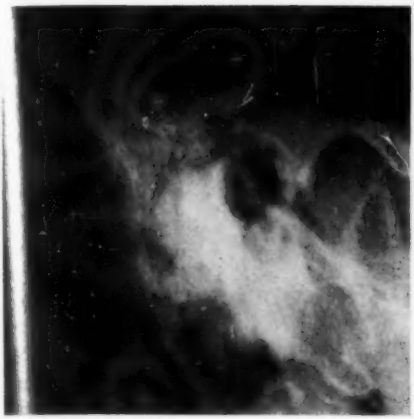


Fig. 14.

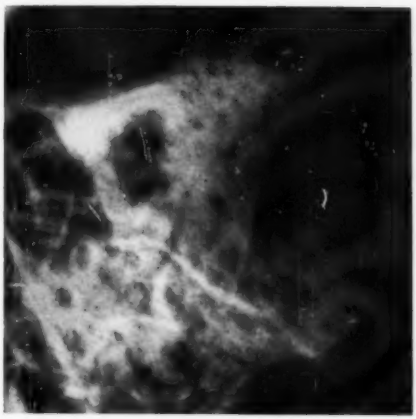


Fig. 15.

Fig. 14. Case 7. Left ear. Cell system of rather small extent. The cell cavities are small with thick, rough walls. A small number of larger cells dispersed, especially near the sinus-dura angle and down towards the mastoid process. Chronic productive mastoiditis.

Fig. 15. Case 8. Right ear. Cell system with thick and rough bony trabeculae and small cell cavities in the base of the pyramid. In the mastoid process there are along the sinus also a number of larger cavities: large cells or destructions? Chronic mastoiditis.

of a chronic mastoiditis. Radical operation. Histology revealed, amongst other things, a rather pronounced ossification.

Extracts from case record: The patient sought medical attention on 24. 8. 43 for increasing deafness. He had had discharge from the ear as a child, but the ear had now been dry for many years. A large marginal perforation was found bilaterally; not quite dry on the left side. Conservative treatment. On 27. 4. 44 cholesteatoma and increasing secretion was observed on the left side.

Roentgen examination on 27. 4. 44. Fig. 14. Left ear. Pneumatization of limited extent not reaching quite down in the mastoid process. The cells small with thick, rough walls; there were also a few somewhat larger cells especially near the sinus-dura angle and in the process. No demonstrable extension of the aditus and no visible destruction.

Further conservative treatment. On two occasions the patient felt giddy. It was therefore decided to operate.

Operation on 20. 5. 44. Radical operation of left ear. Thick corticalis externa. Rather small cell system with only dispersed cells. Thickened mucous membrane everywhere. Blackish-brown discolouring in the mastoid process. The whole aditus and adjacent part of the mastoid antrum filled with granulations which, in one place, exposed the dura in the middle cranial fossa. After removal of the bridge a cholesteatoma was exposed which had eroded the central part of the horizontal semicircular canal. A labyrinthine fistula was found here which, even at an early stage of the operation, had shown fistulous signs in response to pressure on the granulations in the aditus. The cholesteatoma, which was

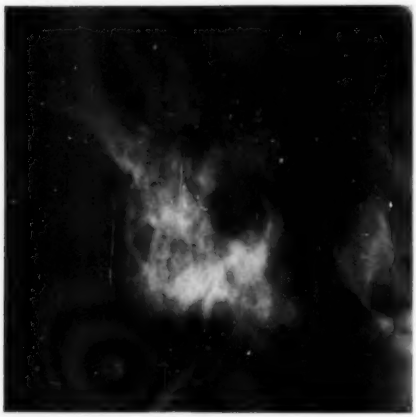


Fig. 16.

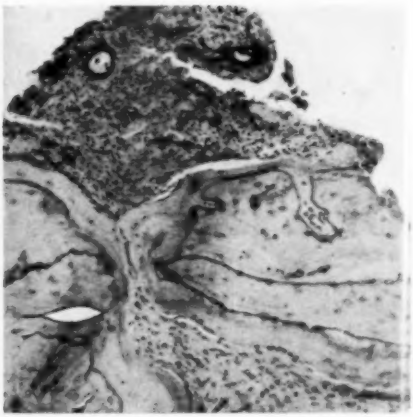


Fig. 17.

Fig. 16. Case 9. Left ear. Thick bony trabeculae with uneven contours surrounding small cell cavities as in cases of chronic mastoiditis.

Fig. 17. Fragment of bone from the mastoid process partly covered by a fibrous, thickened mucous membrane which is permeated with round cells. The bone shows a pronounced reconstruction and thickening; the border between older and newer layers are marked by distinct calcic streaks. (Case 7. Htx-eosin).

flat, was of considerable extent and, in the tympanic cavity, reached as far as the mouth of the Eustachian tube and down towards the stapes.

Histological report. Pathol. Inst. Lund. No. 2871/1944. The scraped out fragments from the mastoid process showed a cell system with rather pronounced inflammatory changes. The mucous membrane was swollen, edematous, rather rich in vessels and permeated with a thin, round-cell infiltration. The covering epithelium was hyperplastic. The cell cavities contained a slimy content mixed with lymphocytes. The bony trabeculae showed signs partly of a lacunar resorption and partly a rather pronounced formation of new bone. The intraosseous vascular spaces were extended. No signs of tuberculous inflammation anywhere.

The fragments from the middle ear consisted of cholesteatomatous masses built up of layers of necrosed, laminated epithelia with horny masses.

Diagnosis: Cholesteatoma + chronic mastoiditis (AHLSTRÖM).

(8) F. H. J., Male. Aet. 38 years. *Summary.* After discharge from the ear of many years duration, a central perforation, secretion and polyp were observed. The roentgen picture showed marked thickening and roughness in the cell walls and a number of cavitations in the mastoid process. This was confirmed by the operation which also revealed cholesteatoma in the epitympanum. The reason why the cholesteatoma could not be seen on the roentgen picture is probably due to the pronounced density in the surroundings. Radical operation.

Extracts from case record: The patient sought medical attention on 28. 7. 42 for laby-inth symptoms. The patient had otitis for the first time in 1926 and since then has had lischarge from the ear. Five days before admission he felt giddy when turning his head ut was better when keeping still; he had vomited a few times. Central tympanic per-oration with secretion and large fibrous polyp from the region of fenestra ovalis was bserved. There was caloric reaction and the patient lateralized clearly to the right ear. Vhispering 1 dm.

Roentgen examination on 28. 7. 42. Fig. 15. Right ear. The cell system of moderate xtent but nevertheless extended far backwards along the sinus. The cell trabeculae were hick and rough, and the cells small in the base of the pyramid. There were also a number f larger cavities in the mastoid process; as to whether these were large cells or estructions could not be definitely decided. The roentgen findings coincided with the icture of chronic mastoiditis.

Operation on 30. 7. 42. Radical operation. Corticalis externa 1 cm in thickness. loderately extensive cell system with a few larger cells peripherally. A large cavity was urrounded by single cells, separated by thick walls in the base of the mastoid process. 'hickened mucous membrane. The cells contained a yellowish fluid and putty-like detritus. 'he antrum was almost completely cut off from the aditus. After a widening of the narrow ieatus one entered a cavity the size of a hazel-nut in the epitympanum which was ntirely filled with cholesteatoma. This extended as far as the mouth of the Eustachian tube. The fibrous polyp was also removed.

(9) J. S., Female. Aet. 42 years. *Summary.* After a discharge from the ear for 20 years, a sub-total perforation was found with antrum fistula and cholesteatoma. The roentgen picture showed chron-ic mastoiditis. This was confirmed on operation which also showed that the clinically demonstrated cholesteatoma covered the epitym-panum. Radical operation.

Extracts from case record: In 1917 a radical operation was performed on the patient's right ear after discharge from the age of 10. She sought medical attention on 26. 11. 38 for a discharge from the left ear which she had had for the past 20 years. The left ear showed sub-total perforation with antrum fistula and secretion.

Roentgen examination on 28. 11. 38. Fig. 16. Left ear. Cell system less than medium size. The cell trabeculae were thickened and rough and the entire structure irregular. No demonstrable destruction.

Conservative treatment for six months resulted, for periods, in a practically dry ear. On 10. 5. 39 cholesteatomatous flakes were seen in the antrum fistula.

Operation on 21. 8. 39. Radical operation. The cell system was of medium extent with relatively few cells. The cells were rather large with thick, hard walls and a turbid fluid content. In the middle cranial fossa the dura was exposed over an area the size of a halfpenny but there were no signs of abscess or marked irritation. One caught a glimpse of the cholesteatoma in the epitympanum and a radical operation was therefore per-formed. Malleus and incus carious. The cholesteatoma covered the entire epitympanum and enclosed the region of fenestra ovalis.

Clinically these cases present a motley picture. The otoscopic find-ings vary greatly. In case 4 one finds a normal tympanum, in case 5 a pale, indrawn scar whilst in cases 1, 2 and 3 there is a tympanic

picture resembling acute otitis. Central perforation was observed in cases 6 and 8 and a marginal perforation in case 7 whereas, finally, in case 9 the perforation was sub-total.

Cholesteatoma was observed clinically in cases 7 and 9 as well as in case 8 during the operation. It may seem strange that it was not possible to demonstrate the presence of cholesteatoma roentgenologically in any of these three cases. In three other cases — 1, 2 and 5 — the operation disclosed destructions in the vicinity of the antrum and these, too, were not visible on the roentgen pictures. It would now appear that one has reached the limits of the possibilities afforded by the roentgenological method. Small erosions caused by cholesteatoma and osteitis adjacent to the antrum are often difficult to demonstrate. The chronic mastoiditis with osseous accretions on the cell walls and increased density of the bone in the surroundings seem to render it more than usually difficult to establish the presence of small erosions and evidence of osteitis near the antrum.

Nor do these case-histories reveal any features common to all cases. Prolonged or recurring discharge from the ear has occurred in cases 1, 5, 6, 7, 8 and 9; in case 2 for 3 months and in case 3 for 4 months whilst in case 4 the patient, according to his own statement, has never had any discharge at all from the ears.

From the clinical point of view it has therefore been impossible to classify these cases in one group. The features in common are, however, the roentgen revelations, the discoveries made during operation and the patho-histological changes. The characteristic features on the roentgen pictures are the thick bony trabeculae which roughen towards the cell lumen that generally enclose small, dispersed cells and, in some cases, partial destructions. The discoveries made during operation consist of thick, hard walls around the cells and, within these, a discoloured or suppurative fluid or putty-like content and, in several cases, smaller destructions as well. The histological examination confirms the diagnosis of chronic mastoiditis, *i. e.* it shows the picture of chronic inflammation. The most interesting feature in the microscopic picture is, however, the occurrence of processes of ossification.

A formation of new bone tissue in the cell walls occurs relatively early in the course of an acute mastoiditis. In one case, not reported here, it was possible, both roentgenologically and operatively to show destroyed areas in the mastoid process four weeks after the patient contracted acute otitis, but it was not possible to show any apposition of bone on the roentgen pictures. Histological examination, however, revealed the presence of pronounced signs of formation of new bone (Ahlström). On several previous occasions Ahlström has made similar discoveries with formation of new bony tissue in cases of acute mas-

toiditis published by WELIN 1941. It is noteworthy that even in these acute cases one often finds numerous trabeculae of osteoid tissue as an expression of reactive formation of new bone. But as we know that osteoid tissue is not calcareous, this early apposition of bone cannot be shown on the roentgen picture. The osteoid tissue however, gradually is converted into calcareous bone. In our histological preparations from cases of chronic mastoiditis, the newly formed lamellar bone has also been shown to be a deposit on bone substance of older structure.

Professor AHLSTRÖM has been kind enough to place at our disposal a histological preparation of that kind from case 7. Fig. 17.

This histologically demonstrated formation of new bone doubtless corresponds to the characteristic changes in the bony trabeculae of the roentgen picture.

It is interesting to note, in one of our cases (2), a distinct roentgenologically demonstrable formation of new bone tissue, microscopically confirmed within three months after the ear began to discharge.

It may perhaps be of interest here to remind the reader of the appearance on the roentgen picture of newly formed bone in other parts of the body. After a chronic osteomyelitis, for example, one sees a broadening of the bone which shows a rough edge and an increased absorption of the roentgen rays in the bone so that the newly formed bone appears denser than normal. By means of this one may probably compare the roentgenologically visible changes in the cell system with the thick, uneven bone trabeculae. One thus finds here, influenced by a chronic inflammation, exactly the same biological picture.

Another question of interest is whether a picture of chronic mastoiditis, such as has been described here, usually arises in a cell system within regular thin-walled cells. It is possible that a cell system of a particular structure has, in certain cases, a tendency to produce a chronic mastoiditis of this kind. Actually it has also been possible to show, in normal material, in which otitis has never occurred, a cell system with small irregular cells rather widely separated by broad, clumsy bony trabeculae; but naturally these have not the rough appearance indicative of ossification usually found in chronic mastoiditis. It is possible that, in certain cases at least, the cell system may have had an unusual character from the outset predisposing the subject for chronic mastoiditis.

One asks oneself whether chronic mastoiditis is commoner than seems to appear from our material. The diagnosis chronic mastoiditis must be very much easier to establish roentgenologically if the cell

system extends over a large area. The typical changes are more outstanding if they are found in a large area. In our cases the cell systems have all been of moderate size. If, however, there are only a few cells, surrounded by dense bone, the difficulty in showing a roughness in the cell walls of the lumina must be greater. The present material does not allow of any definite conclusions.

The motley picture of clinical symptoms in chronic mastoiditis seems to indicate that it is usually not possible to make a diagnosis by means of otological methods of examination alone. On the other hand, the diagnosis is easy, in typical cases at least, if one pays due attention to the possibilities offered by the roentgen.

A knowledge of the presence of a chronic mastoiditis of this kind seems, in any case, to add to the possibilities of an all-round judgement of a case and the therapeutic measures that should be adopted. An insidious chronic infection in the cell system must always be burdensome to the patient. It makes it difficult, or even impossible, to get rid of a chronic discharge from the ear by means of conservative syringe-treatment. It is considered that a prolonged ear-discharge can give rise to increasing deafness because of its effect on both the middle ear and the auditory nerve. Finally, it would seem probable that an infection of this nature entails all the complications connected with acute mastoiditis. Masked mastoiditis may often arise by resorting to the chemotherapy now used in acute otitis and this must also entail increased risk of the occurrence of chronic mastoiditis. A knowledge of locating the source of infection and the possibility of removing it by operation seems to be essentially important.

SUMMARY

The authors have collected a number of cases under the heading »Chronic mastoiditis», and give an account of nine cases showing a creeping, indolent infection in the cell system of the ear which appears on roentgen examination with characteristic signs of reactive formation of new bony tissue. The pathological process reveals itself in the following manner: the unusually thick bony trabeculae in the cell system present uneven, rough contours towards the cell lumen; in some cases partial destructions can be seen. The cases have been operated on and the operation disclosed characteristic inflammatory changes. By histological examination in four of the cases newly formed bone has been shown in the form of accretions on the bone-substance of older structure. The clinical picture varies greatly. Chronic mastoiditis has occurred in cases of chronic discharge from the ear with tympanic perforation of various kinds, in cases of acute otitis of long duration and also behind the normal tympanic membrane.

ZUSAMMENFASSUNG

Verff. haben unter dem Namen chronische Mastoiditis gewisse Fälle zusammengestellt, von denen 9 hier veröffentlicht werden, die eine schleichende, indolente, im Rönt-

enbilde charakteristische Anzeichen reaktiver Knochenbildung aufweisende, Infektion les Zellensystems des Ohres zeigen. Der pathologische Prozess verrät sich dadurch, lass die ungewöhnlich groben Knochenbälkchen, die das Zell-lumen begrenzen, ungleichnässige, aufgerauhte Konturen aufweisen; in einigen Fällen sind ausserdem partielle Zerstörungen sichtbar. Die Fälle wurden operiert, und der Operationbefund weist harakteristische entzündliche Veränderungen auf. Vier der Fälle wurden histologisch ntersucht, wobei neugebildeter Knochen als Auflagerungen auf Knochensubstanz on älterem Bau nachgewiesen wurde. Das klinische Bild weist bemerkenswerte chwankungen auf. Chronische Mastoiditis kam sowohl bei chronischem Ohrenausfluss it Trommelfellperforation verschiedener Art und bei langdauernder akuter Otitis als ach hinter normalem Trommelfell vor.

RÉSUMÉ

Sous le nom de mastoïdite chronique les auteurs ont groupé un certain nombre de cas, dont 9 ont été publiés, présentant dans le système cellulaire de l'oreille une infection latente et indolente qui se manifeste à l'examen radiologique par les signes caractéristiques d'une néoformation osseuse. On reconnaît le processus pathologique à ce que les parois osseuses du système cellulaire, anormalement épaisses, ont des contours inégaux et raboteux, du côté de la lumen qu'elles delimitent; dans certains cas on voit s'y ajouter des destructions partielles. Les cas ont été opérés, et l'intervention a permis de constater des lésions inflammatoires caractéristiques. Dans quatre on a procédé à un examen histologique, lequel a montre de l'os néoformé sous forme d'appositions à la surface de la structure osseuse plus ancienne. Le tableau clinique varie de façon notable. La mastoïdite chronique a été rencontrée aussi bien dans des cas d'écoulement chronique avec perforation de la membrane du tympan de diverse nature que dans des otites aiguës prolongées, mais on l'a même vue exister derrière un tympan intacte.

BIBLIOGRAPHY

ALBRECHT, Ueber Konstitutionsprobleme in der Pathogenese der Hals-, Nasen- und Ohrenkrankheiten. Zschr. f. Hals-, Nasen- und Ohrenheilkunde 29, 1931.

DAHLBERG, G. and DIAMANT, M., Inheritance of Pneumatisation of the Mastoid Bone. Hereditas, 31. 1945.

DAHLBERG, G. and DIAMANT, M., Hereditary Character of the cellular System in the Mastoid Process. Acta Oto-Laryngologica 33, 1945.

DIAMANT, M., Otitis and Pneumatisation of the Mastoid Bone. Lund 1940.

GOERKE, M., Die exsudativen und plastischen Vorgänge im Mittelohr. Archiv für Ohrenheilkunde 65, 1905.

MAYER, E. G., Otologische Röntgendiagnostik. Handbuch der Röntgenkunde, B. II. Vienna 1930.

MEYER, W., Ergebnisse röntgenologisch-klinischer Untersuchungen zur Frage der sekundären Sklerosierung des Warzenfortsatzes. Archiv für Ohren-, Nasen- und Kehlkopfheilkunde 130, 1932.

MITTERMAIER, R., Röntgenologischer Beitrag zur Frage der Knochenneubildung bei Mastoiditis. Zschr. f. Hals-, Nasen- und Ohrenheilkunde 45, 1940.

RAINER, A., Untersuchungen über die Entwicklung und der Ausbau der Pyramidenzellen. Archiv f. Ohren-, Nasen- und Kehlkopfheilkunde 145, 1938.

SCHWARZ, M., Die Bedeutung der hereditären Anlage für die Pneumatisation der Warzenfortsätze und der Nasennebenhöhlen. Archiv für Ohren-, Nasen- und Kehlkopfheilkunde 123, 1929.

WELIN, S., Beiträge zur Röntgendiagnostik der Otitis acuta und ihrer Komplikationen im Schläfenbein. Acta Radiologica, Suppl. XLII, 1941.

WITTMAACK, Ueber die normale und die pathologische Pneumatisation des Schläfenbeines einschliesslich ihrer Beziehungen zu den Mittelohrerkrankungen. Jena 1918.

ZIEGLER, E., Knochenneubildung bei Mastoiditis. Zschr. f. Hals-, Nasen- und Ohrenheilkunde 39, 1936.

FROM THE ROENTGENOLOGICAL DEPARTMENT OF THE UNIVERSITY CLINIC OF OSLO (CHIEF: PROF. T. DALE) AND THE NEUROSURGICAL SUBDIVISION (CHIEF: DR. A. TORKILDSEN) OF THE NEUROLOGICAL DEPARTMENT OF THE UNIVERSITY CLINIC OF OSLO (CHIEF: PROF. G. H. MONRAD-KROHN)

ON CHANGES OF THE OPTIC CANAL IN CASES OF INTRACRANIAL TUMOR[1]

by

Arne Engeset and *Arne Torkildsen*

MARTIN & CUSHING (1923) and LYSHOLM & OLIVECRONA (1932) have discussed certain changes of the optic canal in cases of intracranial tumor. By chiasmal gliomas and suprasellar cholesteatomas was found dilatation of one or both optic canals and the chiasmal sulcus, while sella turcica appeared normal. LYSHOLM & OLIVECRONA pointed out that destructive changes may be seen *in the walls* of the optic canal in cases of pituitary tumor combined with the usual changes of the sella turcica and its neighbourhood. They showed characteristic pictures of destruction of the lower lateral wall of the optic foramen, but have not in their conclusion stressed the fact that the destructive changes were *localized* to the lower lateral wall. They do not convey to the reader the importance and the consequence of this observation.

In 1927 GOALWIN published three cases of interest in this connection (one case of optic glioma and two cases of pituitary tumor), showing destruction of *the bridge* between the optic foramen and the sphenoidal fissure.

In 1933 A. BEUTEL pointed out that he and other investigators (SCHULLER, VAND DER HOEWE, E. G. MAYER, a. o.) had seen dilatation of one or both optic canals in cases of increased intracranial pressure. He described destructive changes of the lower lateral wall of the optic canal in cases of carcinoma and sarcoma near the optic canal and the sella.

In 1937 G. JEFFERSON and TWINING noted destruction of the lower lateral wall of the optic canal in cases of aneurysm of the carotid syphon. JEFFERSON states: »another feature is visible erosion of the lower and

[1] Read at The Nordisk Radiolog Kongress, Copenhagen, June 1946; submitted for publication July 9, 1946.

outer wall of the optic canal, a point which TWINING and the writer have come to regard as almost, if not quite, pathognomonic of aneurysm of the anterior end of the carotid artery».

In another paper JEFFERSON designated the lower and outer wall of the optic canal the »sphenoid strut», a term which we have used also, unaware until recently of his suggestion.

This anatomical structure, which GOALWIN calls the »the bridge», has no specific anatomical name (K. E. SCHREINER). It is a bone lamella of variable length and thickness forming the lower lateral wall of the optic canal. It passes from the body of the sphenoid to its lesser wing. In spite of certain variations it is seen so constantly and clearly on correctly taken roentgen pictures of the optic foramen, that destructive changes, when present, are easily detected.

PANCOAST (1935) has studied cases showing localized destruction of *the roof* of the optic canal. In two cases of meningeoma and in one case of fibrillary astrocytoma he could demonstrate destruction of the roof of the optic canal on the same side as the tumor. In one case, however, destruction of the roof of the optic canal was seen on the healthy side. In PANCOAST's opinion this was due to pressure from the dislocated 3rd ventricle.

FARBEROW (1937) advises great caution in evaluating the contours of the roof of the optic foramen. In 400 cases he has found erosion of the roof in 4 cases. In 3 of these the erosion was unilateral. These patients, however, were examined because of ophtalmological diseases. Many investigators have seen distinct unilateral dilatation (at times combined with peripheral destruction of the optic foramen) in cases of glioma of the optic nerve. GOALWIN stressed the circular form, but as pointed out previously, he has described one case of glioma of the optic nerve showing destruction of the *sphenoid strut*. Others have described dilatation of the optic foramen in cases of intracranial hypertension.

According to GOALWIN, the optic foramen may vary between 4.1 mm. and 4.65 mm. in normal cases (focal distance 52.75 m.). LINDBLOM (1936) considers 5 mm. the normal limit, using the skull table of LYSHOLM. KEYS and PFEIFFER did not consider this measurement reliable.

With the aid of the experiences published in the literature, we have in recent years routinely taken roentgen pictures of the optic foramina in all cases from the department of Neurology and Neurosurgery as well as in all cases from the department of Ophthalmology which have been sent in order to have roentgen pictures taken of the skull. We have been using the »localizer» of CAMP & GIANTURCO which we have found to be of great help, but also by the method of PFEIFFER satisfactory pictures may be obtained. All our examinations have been carried out using the skull table of LYSHOLM.

Fig. 1.

Fig. 2.

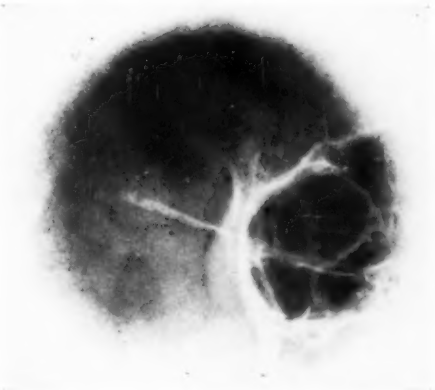


Fig. 3.

Some cases showing characteristic findings shall be demonstrated below.

C a s e 1. R. Br. 23 years old woman. Lpnr. 7262/46. She was admitted to the Neurological department because of failing vision for 2 years. The loss of the sight was especially marked on the right side.

Roentgen pictures of the skull Dec. 21 1945 showed dilatation of the sella, destruction of the »sphenoid strut» (fig. 3) and destruction also of the adjacent portion of the greater sphenoid wing.

Diagnosis: Intrasellar or parasellar tumor on the right side (Figs. 1, 2 & 3).

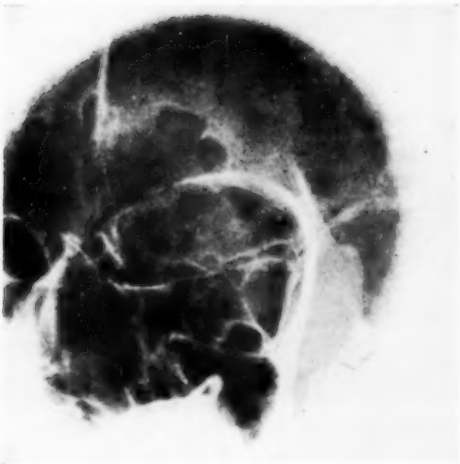


Fig. 4.

Cerebral angiography was carried out on the right side on January the 1st 1946. The pictures showed elevation of the carotid syphon on the right side and also elevation of the Sylvian vessels on that side. M. 1 (using the terminology of Fisher) was not elevated, making the diagnosis of tumor in the temporal region improbable.

Diagnosis: Expanding lesion located centrally in the temporo-parietal region.

The destruction of the sphenoid strut was considered to be the most significant localizing symptom. The angiographic examination suggested that the lesion was rather extensive and voluminous. At *operation* (TORKILDSEN) a tumor was found, but on attempt to dissect it free from the carotid wall troublesome bleeding occurred. The patient died a few days later. *Autopsy* (Dr. J. CAMMERMEYER) showed a large pituitary adenoma invading the basal structures of the cerebrum and embracing the right fasciculus opticus. The rostral portion of the neoplasm dislocated the floor of the 3rd ventricle and the anterior commissure of the lenticular nucleus. Histological examination: Eosinofilic adenoma.

C a s e 2. L. H. 30 years old man. *Lpnr. 7301/47.* The patient had suffered from headaches for several years. During the last 6 months he had noticed loss of vision. On admission to the hospital examination revealed bitemporal hemianopsia.

Roentgen pictures of the skull. Sept. 9th 1946 showed destruction of the sella turcica. There was destruction also of the »sphenoid strut» of the left optic canal. (Fig. 4.)

Diagnosis: Intrasellar or parasellar tumor near the left optic foramen.

At *operation* (TORKILDSEN) a pituitary tumor was removed. Histologic examination showed chromofilic adenoma, possibly with atypical cells. Recurrence of the tumor was noted in December 1946 necessitating reoperation with further removal of neoplastic tissue. He was given a series of roentgen treatments and is at present time free of symptoms.

C a s e 3. K. To., a 52 years old woman. *Lpnr. 7012/44.* The patient had suffered from headaches for the previous 5 years. There had been failing vision of the right eye for one year, and signs of intracranial hypertension for the last 3 months before admission. Exophthalmus was seen on the right side, and also a partial sixth nerve palsy on the right. There was some deviation of the jaw to the left.

Fig. 5.

Fig. 6.

Roentgen examination of the skull Jan. 11th 1944: Destruction of the right »sphenoid strut» and the adjacent portion of the greater sphenoid wing. There was a large destruction of the sella turcica. An arcuate linear calcification was seen above the sella with its convexity upwards. (Fig. 5 & 6.)

Cerebral angiography was carried out Jan. 24th 1944 showing elevation of the carotid syphon upwards, backwards and laterally.

Diagnosis: Intra-sellar or para-sellar expanding lesion close to the optic foramen on the right side. The angiographic study did not support the diagnosis of aneurysm which had come into consideration because of the line of calcification.

At *operation* (TORKILDSEN) a large tumor in the pituitary region was disclosed and partially removed, decompressing the right optic nerve. The tumor was partly cystic, allowing the removal of about 8 or 9 cc. of fluid.

The patient was discharged to the department of internal medicine in order to receive treatment for another ailment. There she died. *Autopsy* revealed a craniopharyngeoma.

Case 4. K. H., a 59 years old woman. *Lpnr. 13378/44.* For about one year she had suffered from headaches and gradual loss of vision on the left eye. She also noted diplopia and suffered from local pain referable to the 1st trigeminal branch on the left side.

Roentgen examination of the skull June 17th 1944 showed destruction of the dorsum sellae and distinct destruction of the left »sphenoid strut». A tiny irregular calcification was seen in the sellar region. (Fig. 7 & 8.)

Diagnosis: Intrasellar or parasellar tumor with calcification near the left optic foramen. Operation (TORKILDSEN) disclosed a osteofibroma in the region of the left

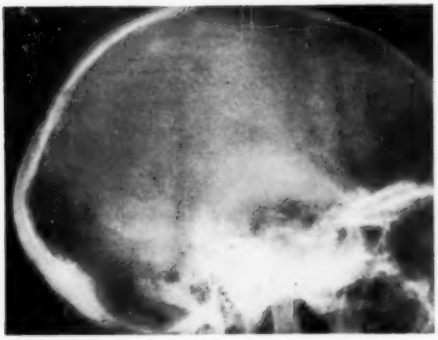


Fig. 7.

Fig. 8.

Gasserian ganglion. The tumor was of the size of a cherry. On opening the capsula the neoplastic mass herniated under pressure through the capsular incision.

Comment

The above 4 cases are examples of neoplasms in the sella or near the sella provoking localized destruction of the »sphenoid strut» on the one side.

In our experience no other neoplasms result in such changes. In cases of generalized intracranial hypertension one or both optic foramina may become dilated, and one may even find atrophy and thinning of the roof of the optic canal. Our material contains examples of malignant neoplasm in the orbit causing extensive dilatation of the optic foramina, but they fall outside the scope of this paper.

It is conceivable that large pituitary tumors may cause destruction of both »sphenoid struts». This seems however to be a very rare finding. In our material we have seen only one example of such condition.

We have never seen tumors growing at some distance from the sellar region, including cases of generalized intracranial hypertension, causing localized destruction of one or both »sphenoid struts».

The only other pathological anatomical condition which in our experience is known to cause destruction of the »sphenoid strut» is aneurysm of the extradural part of the carotid syphon.

The roentgenological diagnosis of generalized intracranial hypertension is probable in case one can demonstrate thinning of the roof of both optic foramina.

Localized *unilateral* destruction of the roof of the optic foramen is of dubious localizing value, both concerning the side on which the tumor grows and concerning the exact localization.

SUMMARY

Four cases of intra-sellar and para-sellar neoplasms presenting destruction of the »sphenoid strut» are reported. This pathological anatomical condition may be found associated with a variety of tumors and with aneurysm. Destruction of the »sphenoid strut» is independent of the type of the lesion, but is highly significant of its localisation.

Cases of enlarged sella turcica showing destruction of the »sphenoid strut» are usually seen in patients where signs of increased intracranial tension is absent.

ZUSAMMENFASSUNG

Es wird über vier Fälle von paraselluären und intraselluären Neubildungen mit Zerstörung des »Spenoidkeils» berichtet. Dieser pathologisch-anatomische Zustand kann bei verschiedenen Tumoren sowie bei Aneurysma auftreten. Die Zerstörung des »Sphenoidkeils» ist unabhängig von der Art des Leidens aber durchaus charakteristisch für diese Lokalisation. Fällen mit vergrösserter Sella turcica und Zerstörung des »Sphenoidkeils» kommen im allgemeinen vor, wo keine intrakranialen Drucksteigerung vorliegt.

RÉSUMÉ

Relation de quatre cas de néoplasmes intra-sellaires ou para-sellaires accompagnés de destruction de l'»entretoise sellaire». On peut rencontrer cette image anatomo-pathologique en association avec des tumeurs variées ainsi qu'avec un anévrysme. La destruction de l'»entretoise sellaire» ne dépend pas du type de la lésion mais est hautement caractéristique de sa localisation. On constate généralement un élargissement de la selle turcique avec une destruction de l'»entretoise sellaire» dans les cas où il n'y a aucune hypertension intracranienne.

REFERENCES

1. Beutel, A.: Pathologische Veränderungen am Canalis Opticus. Fortschritte., Nov. 1933, p. 576.
2. Camp, John D. and Gianturco, Cesare: A Simplified Technique for Roentgenographic Examination of The Optic Canals. Am. J. of Roentg. 1933, p. 547.
3. Cushing, H. and Martin: Arch. Ophthalm. 52, 1923, p. 209.
4. Farberow, B. J.: Roentgenological Diagnostics of the Optic Foramen. Acta Radiol. 1937, p. 594.
5. Fisher, Erich: Die Arteriographische Diagnostik der Stirnhirn- und oralen Stammgangliengeschwülste. Zbl. f. Neurochir. 1939, p. 72.
6. Goalwin, Harry A.: The Clinical Value of the Optic Canal Roentgenograms. Arch. of Ophthalm. 1926, p. 1—20.
7. —, The Profile Roentgenograms of the Optic Canal. Am. J. of Roentg. 1927, p. 573.
8. —, One Thousand Optic Canals. A Clinical, Anatomic and Roentgenographic Study. J. A. M. A. 1927, p. 1745.

9. JEFFERSON, G.: Compression of the Chiasma, Optic nerves and Optic Tracts by intracranial Aneurysms. Brain, *60:* 444, 1937.
10. KEYES, JOHN E. L.: Observations on Four Thousands Optic Foramina in Human Skulls of Known Origin. Arch. Ophthalm. 1935, p. 558—568.
11. LINDBLOM, K.: A Roentgenographic Study of the Vascular Channels of the Skull. Acta Rad. 1936, suppl. XXX.
12. LYSHOLM, E. and OLIVECRONA, H.: On Changes of the Optic Canals in Cases of Intracranial Tumor. Acta Chir. Scand., 1932. p. 197.
13. PANCOAST, HENRY K.: The Roentgen Diagnostic Significance of Erosion of the Optic Canals in the Study of Intracranial Tumors. Annals of Surgery, 1935, 1, p. 246.
14. PFEIFFER: New Technique of Roentgenology of the Optic Canal. Am. J. of Roentg. March 1933.
15. SCHREINER, K. E.: Verbal communication.

STEREO SCREEN PHOTOGRAPHY[1]

by

Tauno O. Mannila

Screen photography has hitherto been used mainly in examinations of the lungs, particularly in mass examinations, for which experience has shown this method to be especially well suited. HAAHTI's investigations have revealed that screen photography can also be used successfully in stratigraphy (tomography, planigraphy). The low costs involved in this method are in this case a considerable advantage. One can make use of fluoroscopy, instead of ordinary chest photo-fluorography, but when stratigraphy is in question a photo must be taken. Using HAAHTI's method, the standard films are substituted by cinefilms, giving pictures, which can be enlarged. The use of screen photography is not restricted solely to chest photo-fluorography and stratigraphy. My experience shows, that clinically useful stereograms can be obtained by means of all kinds of screen photography.

If a roentgen picture of a leg be taken according to the ordinary chest photo-fluorographic method, the practical use derived from the picture depends on the size of same. At a screen—focus distance of 100 to 110 cm, a film measuring *e. g.* 24 × 24 mm will show an image of the whole foot and leg. Such a small picture is, however, of very restricted use. By reduction of the aforesaid distance to 55—70 cm, and especially by reducing the distance between camera and screen, I have been able, as shown by my experiments, to secure pictures with cine-film, that are so sharp that fractures, shadows of foreign bodies and coarser changes in the bone can be detected without magnification. Diagnosis is facilitated by using larger film with a diameter of up to 9 cm. Policlinical bone photography and regular (serial) roentgen control pictures can be substituted by these less expensive miniature pictures, which in my opinion offer numerous advantages, particularly as stereograms.

A stereoscopic examination by means of WILSKA's fluoroscope is, of course, possible but only by the aid of pictures can exact determinations be made. Further, in view of the cost, stereoscopic photography, in which standard size film is used, is limited mainly to special cases in which

[1] Submitted for publication Sept. 30, 1946.

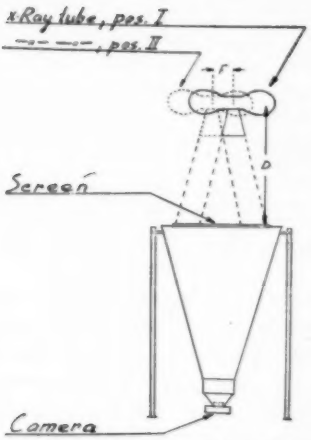


Fig. 1. Sketch illustrating the principles of stereoscopic screen photography. At the top is seen the tube in both positions, with the fluorescent screen in the centre and the camera underneath.

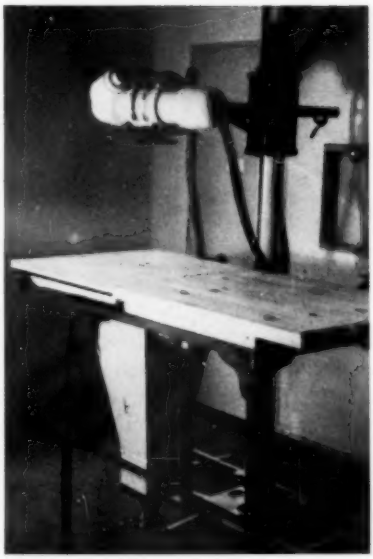


Fig. 2. The apparatus adjusted for photography in vertical projection.

exact localization of splinters is requisite. When miniature film is used in taking stereophotos, the cost is practically negligible.

For the first photo I used an ordinary Siemens screen apparatus, which was attached to a vertical stand and adjusted in front of the fluoroscopic (Siemens Pantoscop) stand. The focus—screen distance was 110 cm, as adjustment did not allow of a shorter distance. The member to be examined was placed either directly against the screen or at a distance of 15 cm from same. In the former case the image was sharper, in the latter it was larger, but more unsharp. The distance of the two focuses on the stereoscopic basis depends both on the focus—screen distance and on the diameter of the member of the body, or, in other words, on the distance of the body surface from the screen. The shorter the distance is between the focus and the screen and the greater the diameter of the member of the body is, the less should the distance be of the focus on the stereoscopic basis. If D represents the focus—screen distance and E the diameter of the member of the body, F, the distance between the two focuses on the stereoscopic basis, can be expressed by the following equation:

$$F = \frac{D(D+E)}{50\,E}$$

Fig. 3. The apparatus adjusted for photography in horisontal projection. The position of the patient is also shown.

If, for instance, the focus—screen distance is 55 cm and a thorax 28 cm in diameter is to be reproduced, F would equal 3.26 cm. The following hyperbola shows the formula with a focus—screen distance of 60 cm.

With regard to the utilization of maximal values, it should, however, be borne in mind that the greater the distance between the two focuses, the more obliquely in relation to one another will the rays fall on the screen lying on a level plane. At the same time, however, the inner dimensions of the picture are enlarged more on the outer side than on the opposite side, where the angle of incidence of the rays on the screen is smaller. The distance between the images is an important factor in stereoscopic fluoroscopy; in stereoscopic photography, however, the distance causes no difficulty. On the other hand, the angle of incidence between the rays meeting the screen must also be taken into consideration in the production of pictures. The shorter the distance between the two focuses, the more true to life will be the inner dimensions of the pictures. An unnecessarily large focus basis should therefore be avoided.

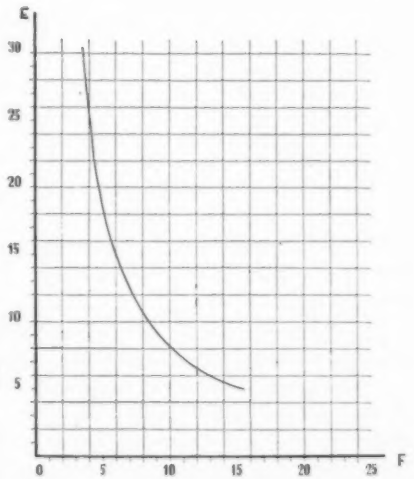


Fig. 4. Curve for use in determining the distance between the focuses in the two stereograms.

The following values were used in experiments in which the focus—screen distance was 110 cm and the camera was attached to the standard screen apparatus.

Fig. 5. Stereo-binoculars with fourfold magnification for examination of the screen photo stereograms. The latter are shown held in the examiner's right hand, framed in cardboard in their exact mutual position, in order to facilitate handling.

Foot, leg, hand, arm: tension 70 to 75 kV; current 100 mA; time 0.75 to 0.8 seconds; focus, moved from its intermediate position ± 5 cm.

In later experiments the focus—screen distance was shortened to 65 cm, and sharp pictures of *e. g.* the knee were secured with the following values: 70 kV, 60 mA and 0.8 seconds. The displacement of the focus approached the maximal value, being ± 5 cm. By shortening the focus—screen distance it is even possible to reduce the milliampere figures A distance of 65 cm is also suited for examinations of the skull. In hysterosalpingography sharp pictures were secured with the following values: 70 kV, 80 mA, 1.5 seconds, focus—screen distance 55 cm and focus ± 2.5 cm.

To avoid differences between the two pictures, care must be taken to ensure that the member to be photographed remains fixed in one position. In addition, care must be taken to keep the pictures in the right order, as otherwise also the sides of the stereograms may be confounded one with the other.

In addition to the determination of the location of splinters, stereo-screen photographs can be used in the examining of fracture fragments, in establishing the degree of invalidity in bone injuries, in the localization of tumours in the lungs and bones, in the detection and recognition of static changes in the spinal column, as well as in general in all roentgen examinations in which three-dimensional pictures are of importance. The pictures can also easily be affixed to certificates relating to accidents, thus making it possible for an outsider to form an exact opinion of the case without recourse to lengthy explanations.

Small stereophotographs are examined with stereo-binoculars, which magnify the pictures. Such an instrument can easily be constructed with the aid of + 17 dioptric lenses. Seeing that the focus basis can be varied, stereo-binoculars, in which the distance between the oculars can easily be adjusted, are found to be most useful. The pictures can be magnified and projected either by means of the older anaglyph method, or by polarization. Of the two, polarization has, however, more and more come to supplant the colour method, as by its aid clearer, achromatic images can be discerned, while the study of the images is not so trying to the eyes as when anaglyph spectacles are used. The reflection is produced by means of a stereo-projector fitted with a polarization filter and the spectacles used are correspondingly polarized. The same degree of accuracy cannot be obtained as by examination with a stereoscope, but the reflector can be used also for special purposes, *e. g.* in reproducing stereograms to be viewed by several persons at the same time.

I have worked out the technical side of the stereoscreen photography in consultation with a roentgen technician, Mr. K. Noschis, and our joint work is being continued, special emphasis being laid on means of rendering the method as practical and simple as possible. The experiments have been carried out with the sanction of the military authorities.

SUMMARY

The author describes attempts to produce small stereograms of the extremities and other parts of the body by means of stereo screen photography. The method has been found practicable and has been put to clinical use, more particularly in the localization of splinters and fracture fragments, as well as in general roentgen examinations in which three-dimensional views are of value. The cine-film photographs can be examined by means of stereo-binoculars, which magnify the images in a sufficient degree.

ZUSAMMENFASSUNG

Verf. beschreibt Versuche, mit Hilfe stereoskopischer Schirmbilder kleine Stereogramme der Extremitäten und anderer Körperpartien herzustellen. Die Methode hat sich als verwendbar erwiesen und hat klinische Anwendung gefunden, ganz besonders zum Lokalisieren von Splittern und Knochenbruchfragmenten, sowie auch bei gewöhnlichen Röntgenuntersuchungen, wenn ein dreidimensionales Bild von Wert ist. Die Kinofilmaufnahmen können durch ein Stereoskop betrachtet werden, das die Bilder in genügendem Masse vergrössert.

RÉSUMÉ

L'auteur décrit les essais qu'il a faits pour établir de petites stéréographies des extrémités ainsi que d'autres parties du corps par le moyen de la radiophotographie stéréoscopique. La méthode s'est montrée praticable et a été employée cliniquement, en particulier pour localiser les esquilles et les fragments de fractures, ainsi que pour les examens

radiologiques généraux où des images à trois dimensions sont précieuses. Les photographies du format des films cinématographiques peuvent être examinées au travers de stéréoscopes binoculaires qui les agrandissent à un degré suffisant.

REFERENCES

v. Barsay, A.: Raumbild-Fotografie. 1943.
Grashey, R.: Steckschuss und Röntgenstrahlen. Verl. G. Thieme, Leipzig 1938.
Haahti, H. G.: Stratigrammoja kinofilmille. Acta Duodecim 1940: II: 356.
Janker: Leuchtschirmphotographie. Tuberkulose-Bibliothek 69, Leipzig 1938.
Nylander, P. E. A. and Wilska, Alvar: Zur Frage der stereoskopischen Röntgendurchleuchtung in der Chirurgie. Sonderabdruck aus den Acta Duodecim. Ser. B. Tom. XXXIII, Fasc. 2, Helsinki 1942.
Odén, Olof: Röntgenundersökning, Stockholm 1932.

FROM THE DEPARTMENT OF ROENTGENOLOGY OF THE OSLO MUNICIPAL HOSPITAL, ULLEVAAL
(CHIEF: J. FRIMANN-DAHL, M. D.)

ON ROENTGENOLOGICAL DIAGNOSIS OF »JEJUNITIS ACUTA PHLEGMONOSA»[1]

by

O. W. Husebye

Diagnostically speaking the roentgenological examination of acute abdominal diseases generally is of a valuable help to the surgeon. To a great degree this is the case with »jejunitis acuta phlegmonosa».

Among the inflammations of the small intestine one finds rather often descriptions of the acute regional terminal »ileitis». The acute terminal ileitis is well-known. Its symptoms are very similar to those of acute appendicitis, and it has a good prognosis.

The chronical »ileitis» is another well-known condition, which has a tendency to progression and may gradually cause thickening of the intestinal wall, shrinking, signs of intestinal stenosis and formation of fistula. The acute phlegmonous jejunitis, however, is rarely mentioned in the literature.

The first descriptions of the inflammatory status of the small intestine we find in an article from 1846 by COMBE and SAUNDER. It bears the following title: »Singular case of stricture and thickening of the ileum».

In 1934 BROWN, BARGEN and WEBER are of the same opinion, that inflammation in the ileum is not to be distinguished from similar lesions in the »jejunum, ileo-coecal region or colon». Consequently they do not regard regional ileitis as a distinct pathological entity. CORR and BOECK have suggested the joint name »ulcerative enteritis» for these cases.

On perusal of available roentgen literature particularly on this subject one finds that the roentgenological examination of the acute phlegmonous jejunitis is sparingly mentioned. GOTTLIEB and ALPERT describe one case which was roentgen examined, however, during the progress of the disease.

[1] Submitted for publication March 30, 1947.

In 1943 in the Oslo Surgical Society FRIMANN-DAHL, supplementing a discourse by DØHLEN, demonstrated some cases of acute phlegmonous gastritis, duodenitis and duodeno-jejunitis as well as jejunitis.

Evidently the acute phlegmonous jejunitis is far more rare than the terminal ileitis. Besides, the prognosis appears to be more serious when the disease is localised to the upper part of the small intestine. It has a greater tendency to gangrene than the terminal ileitis. Compared with the few cases described the mortality seems to be high. It is unanimously agreed that it is difficult, often impossible, to make an accurate clinical diagnosis of the disease. In most of the cases the diagnosis perhaps is not clear until after performance of laparotomy, or autopsy.

The symptoms which are often violent, may resemble those of perforated ulcer, acute appendicitis, acute cholecystitis, intestinal obstruction, pancreatitis, pneumonia or coronary trombosis.

The uncharacteristic findings in this lesion are often pointed out. The patients suffering from this disease, whom we have had for examination, have always shown indistinct symptoms. As a rule the symptoms have been serious.

The clinical symptoms in acute phlegmonous jejunitis may be: Reduced general state of health, severe pain in the epigastrium or in the entire abdomen, vomiting, intestinal bleeding and fever, frequently fairly moderate, sometimes shivering. Considering the prevalent uncertainty respecting the diagnosis one may presume that the incidence of the disease is somewhat higher than the immediate impression given in the literature.

One must consider the possibility that some cases recover without any definite diagnosis having been made. The violence of the inflammation may vary, likewise its spread in the intestine. Furthermore it may be supposed that the jejunitis may occur, combined with regional inflammation in other parts of the intestine *e. g.* gastro-duodeno-jejunitis or jejuno-ileitis.

In our material the acute phlegmonous jejunitis seems to occur comparatively isolated. Clinically as well as roentgenologically it then gives a more compact picture of the disease. In the following I shall mention some such cases. One may probably consider also the possibility of the disease causing permanent changes in the intestinal wall, perhaps resulting in future recurrence of the condition. (One case from the municipal Hospital Ullevaal seems to point in this direction.)

At the roentgenological Department of Ullevaal Hospital we have endeavoured to arrive at definite data on which to base the diagnosis of acute phlegmonous jejunitis. During the past 3 years we have had fourteen cases of the disease, where we considered to be able for certain to make the roentgenological diagnosis acute phlegmonous jejunitis.

In the cases operated on, or in which has been performed autopsy, the inflammation showed an isolated spread in the jejunum of an unspecific nature Two of the fourteen patients died after having been operated on. In these two cases the diagnosis has been verified histologically. Four other patients were operated on. In one of these cases resection was carried out Everyone of these four patients showed definite signs of »jejunitis acuta».

When evaluating the roentgenological findings it is important to remember the normal conditions in the radiogram of the jejunum.

FORSSELL's monography on the mucous membrane, its qualities and its appearance on the roentgen film, gives us here a solid foundation on which to base our work. In the radiogram and during the screening one finds demonstrated the autoplastic capacity of the mucous membrane together with its variety of patterns formed during the normal process of digestion. Likewise the shifts in the mucous membrane picture due to the quality and the quantity of the intestinal content. In addition the roentgenological examination demonstrates the peristalsis and the movements it causes of the intestinal wall. Important too is the recollection of FORSSELL's ideas about »resting relief» and »working relief» with the numerous filterings and block-up formations of the mucous membrane. Things we know are demonstrated anatomically. Our second working basis lies in the comparison of the roentgen findings with the pathological-anatomical changes found at operation or on post mortem examination.

Jejunum comprises about three-fifths of the small intestine. Generally it is situated upwards to the left in the abdomen, below colon transversum and the stomach, and passes gradually over into the ileum.

There are anatomic variations, however, which give certain differences in the roentgen picture of the two sections. Thus the mucous membrane of the ileum, generally speaking, is smoother than that of the jejunum, whereas the latter has a somewhat larger diameter, the mucous membrane showing more numerous circular folds.

The mesentery gives the whole small intestine a certain free mobility. The jejunum, however, tends to keep its position constantly upwards to the left in the abdomen. The duodeno-jejunal flexure and the Bauhin valve are fixed points. Owing to these conditions the small intestine may be moved freely by palpation and is comparatively easily displaced by neighbouring organs.

As a routine method our patients are always examined first without contrast medium in supine position and in standing position, or lying, usually with the right as well as the left side down. All patients are screened in order to see the diaphragmatic movements or possibly the intestinal movements. To obtain a reliable result in this special condition, however, it has proved necessary to supplement the examination with

contrast medium perorally. Although the flat film gives valuable hints, the contrast examination is of decisive importance in this condition.

Case-reports

In the following I shall briefly mention the clinical history and the roentgen findings in 5 of the patients.

The first patient, O. G., 48 years old was brought into the surgical department with the diagnosis »acute abdomen». The clinical symptoms were severe with heavy pains in the abdomen, vomiting and diarrhoea, in the beginning and then full stop in the bowel, *tp.* 38°.

Abdomen: Distended. Pain most in the left side upwards. Tenderness especially in the left side. The abdominal wall is moving with the respiration.

Urine: Neg. *Faeces:* Not examined. *SR.:* 80 mm in one hour.

Examination of the roentgen-films gives us following finding. (Fig. 1.)

»On the survey picture (A) we find moderate amounts of gas in colon, and upwards in the left side of abdomen we find three meteoristic intestinal loops with uneven contours.

This finding on the survey picture is very important. One can consider it as suspicious for the condition: jejunitis acuta phlegmonosa.

The second picture (B) after contrast meal orally gives us the affected jejunal loops with the caracteristic rough, uneven and the stereotypic condition of the mucosal folds and the stereotypic form of the loops. In standing position (C) we find a sort of fluid level, but not as by intestinal obstruction. It looks more like the condition of subileus.

The fourth picture (D) shows the retention of small amounts of contrast after 38 hours in the affected loops. The rest of the contrast we find in the colon.»

The surgeons were in doubt of the exact diagnosis. The patient was in such condition that they found it indicated to perform an explorative laparotomy. It was found a primary jejunitis phlegmonosa with gangraena of the intestinal loops and signs of peritonitis. The patient died three days after operation.

Histologically the jejunum wall shows total necrosis of the mucous membrane of different degree. Some places the necrosis goes through the intestinal wall. It is a severe infiltration of polynuclear leucocytes with signs of making abscesses. The inflammation is all over of acute purulent character without specificity.

Pat. No. 2, H. P., 60 years old. The day the patient came to the hospital, he suddenly got very severe pains in abdomen. He was admitted to the surgical division with the diagnosis: subileus. *Tp.* 36°.

Abdomen: Slightly distended. Moving freely with respiration. Tenderness in epigastrium with slight defence.

Urine: Negative. *Faeces:* Not examined. *S. R.:* 25 mm in one hour.

By *examination of the roentgenological pictures* (Fig. II A) small amounts of gas are located in colon. Slightly upwards to the left in abdomen we find a small characteristic gas-figure. It is presumed that it represents a small meteoristic intestinal loop.

Picture (II B) after the contrast meal shows the rigid stereotyped jejunum-loop with irregular mucous membrane.

Picture (II C) three hours later in standing position shows small fluid levels in the small intestine. In other words we have the picture of an acute jejunitis.

Explorative laparotomy was performed. Jejunum showed typical phlegmonous infection. The affected loops were resected. The patient recovered. Histologically there were found typical signs of phlegmonous infections.

Fig. I. Case I, O. G. male 48 years old. The first picture (A) shows meteoristic intestinal loops at the left side of columna. Second picture shows coarsely serrated, irregular mucous membranes in the small intestine (B). Third and fourth picture show retention in diseased loops after 11 and 38 hours (C, D).

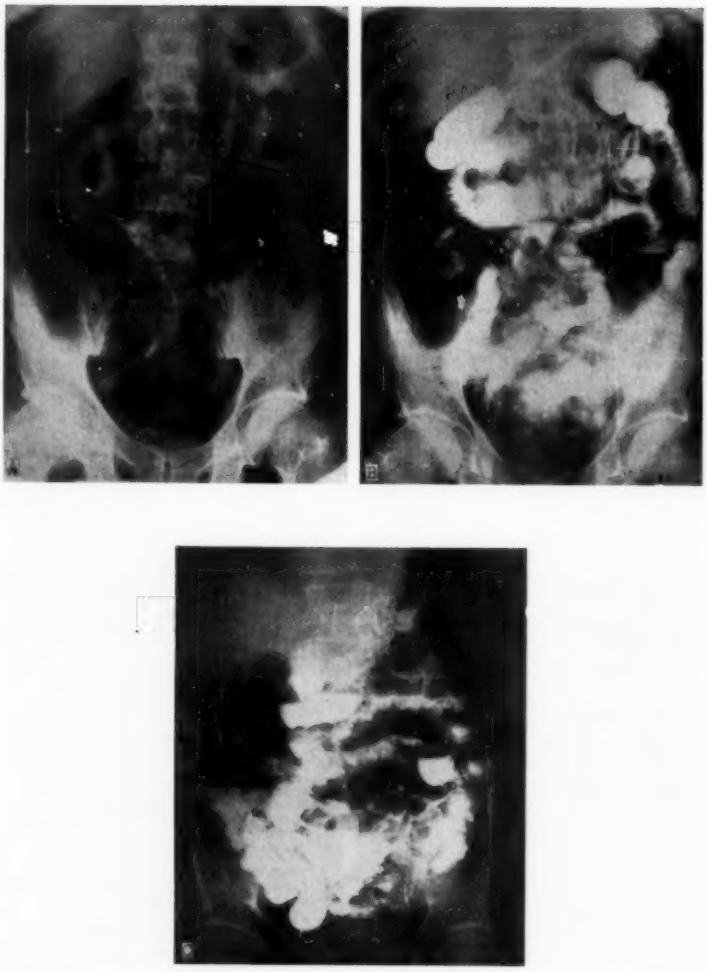


Fig. II. Case II, H. P. male 60 years old. The first picture (A) shows a single, irregular intestinal loop at the left of columna, slightly going upwards. Second picture (B) shows the contrast-filled diseased loop with coarse folds. Third picture (C) shows fluid levels in standing position and meteorism of colon.

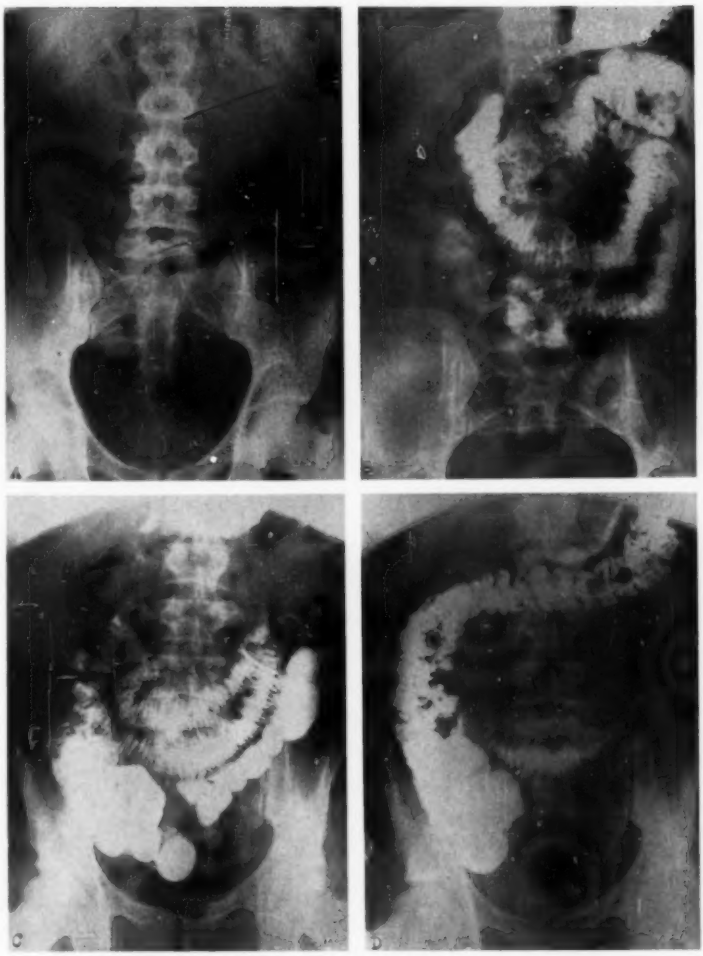


Fig. III. Case III, W. K. 20 years old. First picture (A) shows 3 fairly typical meteoristic intestinal loops in front and at the left of columna. Second picture (B) shows a large intestinal loop with thickening of the wall and coarse folds. Picture C and D show quite nicely retention in the diseased loop after 4 and 9 hours.

Fig. IV. Case IV, H. C. 42 years old. The first picture (A) shows meteoristic intestinal loops going upwards and slightly at the left of columna. Second picture (B) shows the diseased intestinal loop with contrast. The third picture (C) demonstrates retention after 24 hours in the loop. The fourth picture (D) shows control after the treatment. The intestinal loops are again looking normal.

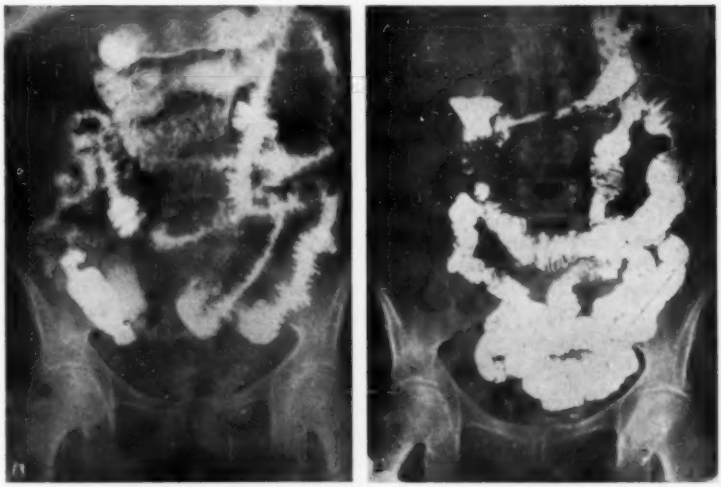


Fig. V. Case V, H. E. 70 years old. The first picture (A) shows the diseased intestinal loops with contrast meal. Second picture (B) shows the normal loops after treatment with penicillin.

Third patient, W. K., 20 years old. For a long time dyspepsia without *relation* to the meals. Frequent vomitings. The day he arrived at the hospital he got very severe pains in the epigastrium. The pains were of an intense aching character. *Tp.* 38°.

Abdomen: Tenderness in the left fossa iliacae and in the epigastrium. Abdomen moves freely with respiration. No defence.

Urine: Negative. *Faeces:* Benzidin +. *S. R.:* 30 mm in one hour.

The roentgen pictures (Fig. III) show — as by the other patients on the survey picture (A) — gas in colon, and typical meteoristic intestinal loops with coarse, irregular contours.

After the contrast meal (B) one sees quite nicely the affected stereotyped jejunal-loop with coarse, irregular mucous membrane, and sign of thickening of the intestinal wall itself.

The last 2 pictures C and D taken 4 and 9 hours after, shows retention in the affected loop. Otherwise the contrast passes through on regular time. There is in other words no apparent delay of the passage through the small intestine.

The patient was treated with sulpha preparates and recovered.

The fourth pat., H. C., 42 years old. For some days abdominal pains. Yesterday vomiting. Urine and faeces normal. The day on arrival: Abdominal pains more severe. *Tp.* 39.2°.

Abdomen: Tenderness diffused over the whole abdomen. No defence. Abdominal wall moving with respiration.

Urine: Negative. *Faeces:* Benz. +. *S. R.:* 62 mm in one hour.

Examination of the radiograms, Fig. IV, gives the same result as by the other patients. On the survey picture (A) one observes three meteoristic intestinal loops with rather irregular contours.

Pictures taken after contrast-meal (B) show the stiff stereotyped intestinal loop with coarse irregular relief of mucous membrane, and sign of retention in the affected intestinal loop after 24 hours (C).

The last picture (D) demonstrates the intestinal loops after the treatment. They are supple, even and freely movable.

She was treated with sulpha preparates and recovered.

The fifth Pat., H. E., 70 years old. Arrived with the diagnosis: »acute abdomen» Perforation? She had very severe pains in abdomen, especially going upwards to the left in epigastrium.

Urine and faeces normal. *Tp.* 36.7°.

Abdomen: Slightly distended. She cries out with pain. Sensitive for palpation in the epigastrium. There is some defence.

Urine: Negative. *Faeces:* Benz. +. *S. R.:* 56 mm in one hour.

The patient was sent to roentgenological examination with inquiry of perforation or lithiasis.

Fig. V shows the condition of the intestinal loops before and after the treatment. Examination of the pictures gave the diagnosis acute jejunitis.

She was treated with sulpha preparates and penicillin and recovered after 2 months.

Our roentgen finding may be summarised as follows:

1) The screening of the thorax shows reduced diaphragmatic movements on one or both sides.
2) The survey film frequently illustrates one or a couple of distended loops of the small intestine localised upwards to the left of the abdomen. The gas formation in the loops often has an unusual, roughly serrated outline. The loops generally display a curve or a faint hook shape. The shape, however, is not so marked as in mechanical ileus. They are rather disinclined to change position or shape, which fact indicates that they are more or less paretic.
3) The film taken in standing position usually demonstrates more or less marked fluid levels as seen in sub-ileus. Larger fluid levels with a corresponding distention of the intestine indicate a complication viz.: peritonitis.
4) The contrast examination demonstrates a roughly jagged relief of the mucous membrane with irregular circular folds of different height and appearance, partly sharp, partly blunt. Besides, one frequently sees a thickening of the intestinal wall. The lumen of the affected loops is not particularly enlarged. One may probably interpret these findings as due to the inflammatory edema of the mucous membrane or of the whole wall of the loops. This finding is in contrast to the regular slender circular fold in the ileum with its thin intestinal wall and the distended lumen. The mucous membrane relief remains unchanged from film to film, in other words: The autoplasticity of the mucous membrane has ceased, or is strongly reduced, in the affected jejunal loop.

Furthermore this examination clarifies and confirms the previously mentioned stereotypy of the intestine. Its normal capacity of constantly changing form and position as a result of outward influence or automatic movement is reduced. The contrast meal examination illustrates from film to film that these jejunal loops keep their constant position in the abdomen and maintain their constant shape of a vague curve or hook form.

5) The large intestine is not, as in intestinal obstruction, completely empty or containing just a little amount of gas. On the contrary, it seems to be characteristic that it contains rather much gas. Numerous small fluid levels may also be seen in the colon. In all our cases gas has been demonstrated in the colon.

6) Usually the passage of the contrast meal through the intestine is not particularly delayed, but it shows that very characteristic condition of the contrast being adhered as a thin covering in the affected loops long after the rest of the small intestine is empty. This symptom also was seen in all of our cases.

7) Free air is seen as a complication (perforation of the intestinal wall). Gradually the roentgenological examination in this condition has become so accurate that in some cases the surgeon, on the strength of this, has omitted to operate. Instead treatment with chemotherapeutics and penicillin has been instituted.

In other words: The systematic roentgenological examination seems to increase the accuracy of the diagnosis, and undoubtedly this fact will be of great importance in the treatment of the patient.

SUMMARY

The author refers 14 cases with most severe and diagnostically unclear abdominal sufferings. They have all been examined roentgenologically with contrast meal. All the roentgen pictures of these patients have been re-examined and compared. The author considers to have shown the typical findings in jejunitis acuta. The diagnosis has given the clinical service great difficulties. Seven of the patients were treated with penicillin and sulphapreparations only and recovered.

ZUSAMMENFASSUNG

Verf. berichtet über 14 Fälle mit sehr ernsten und diagnostisch unklaren Bauchsymptomen. Sämtliche wurden röntgenologisch mittels Kontrastpassage untersucht. Alle die Röntgenbilder dieser Kranken wurden wieder durchgesehen und verglichen. Verf. meint die typischen Befunde der Jejunitis acuta nachgewiesen zu haben. Die Diagnose stellte die Kliniker vor grosse Schwierigkeiten. Sieben der Kranken wurden nur mit Penizillin und Sulfapräparaten behandelt und wurden gesund.

RÉSUMÉ

L'auteur relate quatorze cas qui présentaient des douleurs violentes mais échappant à un diagnostic précis. Tous ont été examinés aux rayons roentgen après administration d'un repas opaque. Toutes les images radiologiques de ces malades furent réexaminées et comparées entre elles. L'auteur estime qu'il a mis en évidence les signes typiques de la jéjunite aigue. Le diagnostic a causé de grandes difficultés au Service clinique. Sept des malades furent traités uniquement par la pénicilline et les sulfamides, et guérirent.

FROM THE ROENTGENOLOGICAL DEPARTMENT OF THE UNIVERSITY CLINIC OF OSLO, NORWAY (CHIEF: PROFESSOR T. DALE, M. D.), AND THE NEUROLOGICAL DEPARTMENT OF THE UNIVERSITY CLINIC OF OSLO (CHIEF: PROFESSOR G. H. MONRAD-KROHN, M. D., F. R. C. P.)

TECHNICAL IMPROVEMENTS IN CEREBRAL ANGIOGRAPHY[1]

by

Arne Engeset and *Hans Kvadsheim*

In angiography it is of prime importance that the exposure should be made at the right and always at the same moment.

In 1937 ZEHNDER reported on an electric contact attachment to the syringe which turned on the roentgen rays at any given position of the piston ensuring a more exact timing of the exposure and thereby also a more exact dosage of the contrast material than was possible by verbal command.

By this technique he could obtain ideal pictures by contrast injection in the internal carotid artery with a dose of 5 cc. of contrast only. Even with a minimum of 3 cc. of contrast he obtained usable angiograms.

He concluded that the new technical procedure had the following advantages:

1) The amount of contrast could be reduced to an optimum dosage (5 cc. in the internal carotid).
2) Exactly adjustable amount of contrast ensuring the best possible angiograms.
3) Elimination of psychic strain and possible misapprehensions within the team-work.

We can only confirm the experience of ZEHNDER. In the past 3 months we have performed about one hundred percutaneous angiographies. The electric contact we have attached to the syringe is of a slightly altered construction, but is principally of the same kind as the syringe contact used by ZEHNDER.

For the common carotid artery we have used 6 cc.[2] of contrast (uriodone, perabrodil and thorotrast), and the electric contact has been ad-

[1] Submitted for publication, March 3, 1947.

[2] Better contrast is obtained with 9 or 10 cc., however, as a rule, especially in the peripheral branches of the vessels.

justed for exposure with 2.5 cc. of contrast remaining in the syringe. The injection time has varied between one and two seconds to get good pictures. The injection appliance may be sterilized and may thus be used in angiographies where the carotid arteries are exposed.

For completeness, however, the method of ZEHNDER may be supplemented by an automatically adjustable exposure of the phlebograms. Upon our initiative and request the firms of Plesner in Oslo and Schönander in Stockholm have constructed and installed a system comprising an electric contact with attachment to the injection syringe, combined with an attachment of an electric timer which turns on the roentgen rays at any given time, from one to ten seconds after the exposure of the arteriogram. For example, to get a phlebogram of the second phase, we adjust the second exposure at 4.5 seconds after the arteriogram. To get a phlebogram of the first phase we adjust the electric timer for exposure 2 seconds after the arteriogram.

For angiography we use the Lysholm-Schönander skull table, with the supplementary casette magazine for two films. A small lamp showing light during each exposure, is mounted in the electric timer to serve as a signal to the assistant who is to pull away the first exposed film (the arteriogram), after which the second casette automatically comes into position for the second exposure (the phlebogram).

Verbal command is consequently unnecessary also at this stage of the investigation.

These technical facilities make the roentgenological procedure in cerebral angiography much more effective, and the demand for trained team-work may partly be dispensed with. Thus the entire procedure is simplified and, besides the advantage justly claimed by ZEHNDER for the arteriogram, the best possible phlebogram is obtained.

In cases with unusual forms of circulation, the examination may be better adapted to such abnormalities in accordance with angiographic factors already in use. This is more difficult when one has to rely on personal evaluation only.

We have used this new technique in cerebral angiography upon more than one hundred patients, and it has always worked well.

Surgical and roentgenological technique in cerebral angiography may be modified to a slight extent, but generally the method is performed as described previously from our departments by ENGESET, EMBLEM and KRISTIANSEN.

We may assume that the above mentioned technique may be utilized in other forms of angiography also, but concerning this we have not had much experience yet. Probably an electric timer with a greater range of variation may be practical, for example between one and thirty seconds.

Fig. 1. At *D* the needle is in position in the artery, and the arterial blood pulses into the syringe, pushing the piston a little upwards by every pulse beat. The electric contact *A* is placed on the syringe and adjusted for exposure at *C*. As the piston is pushed down into the syringe the handle in the right position will touch the lever *B*, and the first exposure begins. At the same time the electric timer *E* starts and simultaneously the signal lamp at *F* burns during the exposure. The exposed film should be taken away by an assistant when the light goes out, while the electric timer is still going. After the adjusted interval the second exposure starts when the electric timer reaches zero, when the signal lamp burns again until the second exposure is finished, and then the electric contact *A* is removed from the syringe. The empty syringe is replaced by another containing saline solution.

Finally we take this opportunity of thanking our technical co-workers G. Alvin, H. Reistad and R. Frost for extremely valuable and indispensable technical cooperation, and of pointing to their results as a great technical achievement.

SUMMARY

A new technical device for cerebral angiography is described. It has been used in more than one hundred cases and has been found to be of considerable advantage. With this technical system it is possible automatically to time the exposure of the arteriograms as well as of the phlebograms in a more exact way than was possible previously by means of verbal command. The method is a further development of that of ZEHNDER. By this method not only arteriograms, but also phlebograms can be obtained with exact timing.

ZUSAMMENFASSUNG

Es wird eine neue Technik für zerebrale Angiographie beschrieben. Sie ist an über hundert Fällen angewendet worden und hat sich als überaus vorteilhaft erwiesen. Mit diesem technischen System ist es möglich, die Aufnahme sowohl der Arteriogramme als auch der Phlebogramme automatisch zeitlich abzupassen und zwar in exakterer Weise als es bisher durch mündliches Kommando möglich war. Die Methode stellt eine weitere Entwicklung der ZEHNDER'schen dar. Mittels dieser Methode können nicht nur Arteriogramme sondern auch Phlebogramme zeitlich exakt aufgenommen werden.

RÉSUMÉ

Description d'un nouvel agencement technique pour l'angiographie cérébrale. Il a été utilisé dans plus de cent cas et a révélé des advantages considérables. Avec ce système technique il est possible de déclencher automatiquement l'exposition, aussi bien des artériographies que des veinographies, de façon plus exacte qu'on ne le pouvait jadis au commandement. Cette méthode représente un nouveau développement de celle de ZEHNDER. Grâce à elle on peut obtenir non seulement des artériographies mais encore des veinographies prises exactement au moment voulu.

REFERENCES

ZEHNDER, M.: Zur Technik der Arteriographie. Zbl. f. Neuro-chir. p. 281, 1938.

ENGESET, ARNE: Cerebral Angiography with Perabrodil (Carotis angiography), Acta Radiologica, Suppl. LVI, 1944.

EMBLEM, LEIF: Erfaringer med perkutan angiografi. Lecture, Congress of Northern Neurologists, Stockholm, 1945.

KRISTIANSEN, KRISTIAN: Perkutan cerebral angiografi. Lecture to the Norwegian Surgical Association, Stavanger, 1946.

FROM THE DEPARTMENT OF ROENTGENOLOGY, OSLO MUNICIPAL HOSPITAL, ULLEVÅL, NORWAY (CHIEF: FRIMANN-DAHL, M. D.)

ON PYELOGENIC RENAL CYSTS[1]

by

Harry Holm

The pyelogenic renal cysts form a special and well-defined group of the solitary renal cysts. A number of characteristic features render them clearly distinguishable from other solitary cysts of the kidney. LJUNGGREN has strongly advocated the term of pyelogenic cysts. This writer has discussed several cases, partly from his own material and partly from the literature he has collected a number of cases where these cysts have been described under many different names, such as: ÖSTLING's isolated calyx dilatations and diverticuli, ITICAVA and TANIO's congential diverticuli, and ASK-UPMARK's description of calyx diverticuli due to deformations. The differential- diagnostic importance of the pyelogenic renal cysts has been emphasised in a number of works dealing with tuberculosis of the kidney, *i. e.* by LJUNGGREN, OLSSON and STEINERT. There also exist individual reports and works by LUDIN and HOWALD, NATVIG and RUDSTRÖM. All these writers describe cysts that in all probability may be classified with the pyelogenic renal cysts.

To day most writers believe developmental defects to be responsible for these cysts. This theory has been maintained by numerous writers, *i. e.* by CARSON, SUNDBERG, DAM, QUINBY, BRIGHT. In the present work the theories of the formation of the cysts as a result of retention and proliferation will not be entered upon. Embryologically there is a marked difference between the pyelogenic and other solitary cysts of the kidney, known as cortical or capsular cysts. Like the renal pelvis, calices and collecting tubules the former belongs to, and derives from the duct of Wolff, whereas the capsular cysts, like the renal ducts and Henley's loops, originate with the metanephrogenic tissue. Therefore KROGIUS has described them as metanephrogenic cysts. They have no primary connection with the renal pelvis. They may grow large, and are often seen to cause changes in the shape and size of the kidney. The contents of the cysts are mostly thin and serous. In contrast the pyelogenic cysts

[1] Submitted for publication, April 17, 1947.

are generally small, as a rule the size varies from that of a pea to that of a hazel-nut. They are mostly round, sharply defined cavities. The construction of the cystic wall is the same as that of the renal pelvis. It is lined with several layers of a transitional epithelium, which however is sometimes partly lost or highly degenerated. The cyst is usually connected with the renal pelvis. The communication may be fairly wide, but as a rule it is very narrow and occasionally partly or entirely obliterated. Retention is often seen in the cysts. Where the communication with the renal pelvis is poor or obliterated, the cystic contents are likely to be strongly viscous, tenacious and with a high percentage of calcium. Like in the renal pelvis there is a marked tendency to the formation of calculi. Therefore the cyst is sometimes detected in patients who have had no symptoms at all from the urinary system. In a couple of our patients cysts have been disclosed during roentgen examination of the stomach.

Formerly the pyelogenic cyst has been considered a rare occurrence compared to other renal cysts. In our experience, from a roentgenologic point of view, the pyelogenic form is by far the most common of the cyst formations in the kidney. Thus a total of 30 cases have been collected from the roentgen department of Oslo Municipal Hospital in the course of the last 3 years. Of these 15 have been female, the rest male cases. Calculi have been found in half the number of cases, mostly multiple, or the cystic contents have been saturated with calcium, so that sedimentation has been visible in roentgenograms taken in erect position. Repeated examinations for tubercle bacilli in cultures, and by inoculation of urine into guinea-pigs have given negative results in all cases. Some of the patients have been in the hospital several times, and up to 14 culture and inoculation tests have been made. The symptoms have been partly due to the wandering of one or more stones, and partly to the evidence of cystopyelitis which have been of a constant recidivating type. Hematuria is a relatively common symptom in the pyelogenic cysts, but as a rule this is caused by calculi and the possible passing of stones.

The cases in our material offer several points of resemblance. In the following some representative cases will be recorded.

Case 1. A. G. Female, 46 years old.

Health previously good. Sudden onset of characteristic attack of renal colic, subsiding after a few hours. The following day the urine was normal, and as the patient was feeling perfectly comfortable, no special treatment was necessary.

At the same time cholecystography and urography have been made. (Fig. 1.) The gall-bladder is found normal. The upper group of calices of the right kidney are somewhat blunt. From this a narrow passage is seen leading to a cavity filled with contrast situated in the upper renal pole. The cyst filling easily in the following retrograde pyelography, but there was some retention and the contrast remained in the cyst after evacuation of the renal pelvis. Nothing else to report about the renal pelvis or calices. The cavity co-

tains a collection of 25 small calculi, resembling sago. (Fig. 2, a.) A roentgenogram taken in erect position show the calculi collected on the cystic floor. (Fig. 2, b.)

Case 2. O. G. Female. 44 years old.

For several years the patient had suffered rom dyspepsia, and a gastric ulcer was once found. On examination of the stomach a round, calcium-aturated shadow was detected, and at first inter-reted as limy bile. Later examinations proved his to be a pyelogenic cyst of the kidney, with tenacious contents, saturated with calcium. A lateral view in erect position without administration of contrast shows a semi-oval shadow posteriorly, comparatively low, as the kidney being movable and sinking. In the pyelograms a cavity about the size of a hazel-nut is seen upwards in the right kidney. Otherwise nothing else is to report from the renal pelvis and calices. A series of pictures show stratification of the tenacious, calcic contents of the cyst. Cholecystography was made at the same time. The patient was examined partly in a horizontal-dorsal position, partly slanting at an angle of 45° and 60°, partly standing up. The cyst is seen to be situated entirely outside the gallbladder. In the slanting positions some of the contents still are seen adhering to the cystic wall. (Fig. 3 a, b, c, d.).

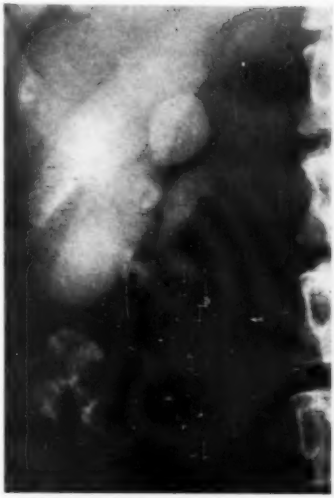


Fig. 1. Case 1. Pyelogenic renal cyst after cholecystography and pyelography at the same time.

Case 3. E. B. Female. 21 years old.

For about 10 years the patient had suffered from constant recidivations of cystopyelitis with dysuria, fever and pain. Culture from urine showed growth of Esheria Coli. Culture and inoculation with a view to T. B. gave negative results.

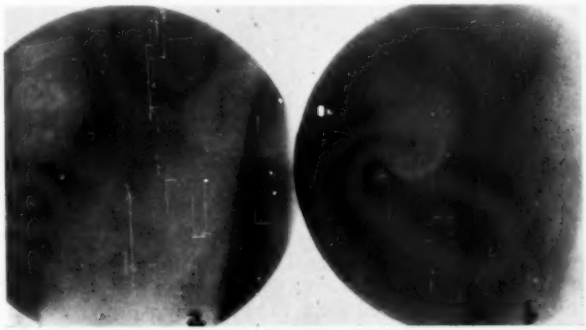


Fig. 2. Case 1. Pyelogenic renal cyst with calculi. a) horizontal dorsal position. b) erect position.

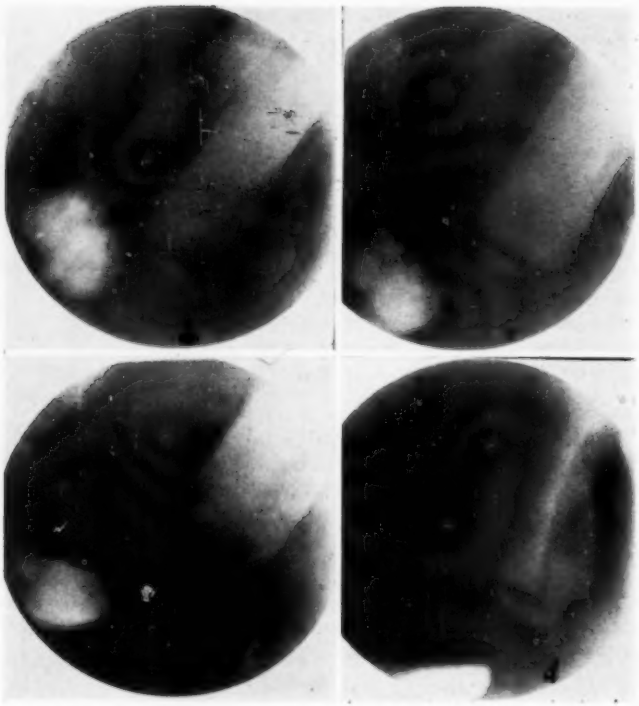


Fig. 3. Case 2. Cyst of the kidney with a tenacious content. Cholecystography and pyelography.
a) horizontal dorsal position, b) slanting position 45°, c) slanting position 60°, d) erect position.

In urography a cyst in the left kidney was discovered about the size of a nut kernel and containing 2 rice-grain-sized calculi. Retrograde pyelography showed good filling of the cyst and a very narrow canal leading to the renal pelvis. (Fig. 4.). Retrograde filling revealed on the opposite side a somewhat large renal pelvis with very short and blunt calices. There was also retention of contrast in the cyst containing the calculi.

As the patient suffered much from her condition operation was indicated. A wedge-shaped resection with removal of the cyst and calculi had been suggested by us, but the surgeon was even more conservative. The cyst was opened and the calculi removed with a small curette. An oval flap of the renal capsule with some fatty tissue was excised and inserted in the cyst, the object being obliteration of the cavity. The result was not good. Another urography showed the cyst to be unchanged. In place of the calculi there was a light area. This defective filling is undoubtedly due to the inserted flap of the capsule which has probably somewhat shrunk, and does not entirely fill the lumen of the cyst.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 4. Case 3. Pyelogenic cyst. Retrograde pyelography.
Fig. 5. Case 4. Pyelogenic cyst. Partial resection gave here very good result.
Fig. 6. Case 5. Hypoplastic right kidney. Pyelogenic cyst at the upper pole of the left kidney.

Case 4. K. R. Female, 44 years old.

For this patient the result of the operation was far more favourable. A smooth-walled pyelogenic and fairly large cyst was found in the left upper renal pole. (Fig. 5.) The cyst contained 4 calculi, the largest of which was about the size of a coffee bean. After liberation and mobilization of the kidney the cyst was incised and the calculi re-

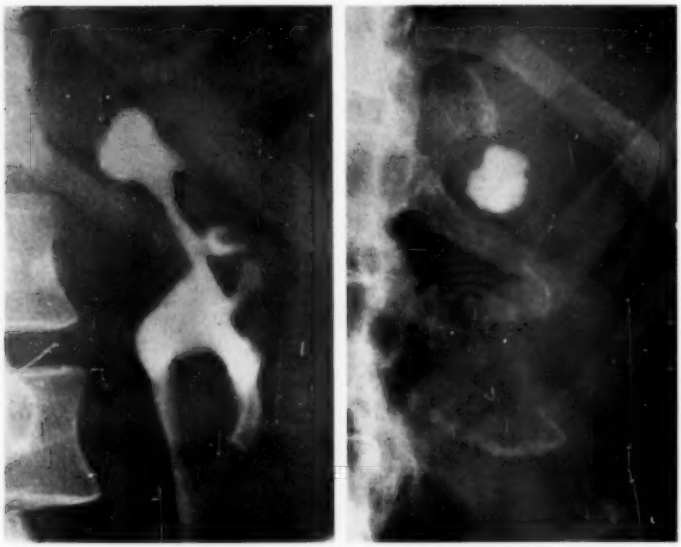


Fig. 7. Fig. 7.

Fig. 7. Case 5. Retrograde pyelography.
Fig. 8. Case 5. Retention of contrast in the pyelogenic cyst. 15 min. after evacuation of the rest of the contrast in the renal pelvis.

moved. Then partial resection was made with removal of as much as possible of the cystic wall. The wound was sutured after insertion of a small catheter. The postoperative course was uncomplicated.

About one month after the operation urography revealed a slightly deformed renal pelvis and a somewhat long and extended upper calyx. There was no cyst and otherwise nothing special was found.

The patient has later been feeling well with perfect relievance of her previous considerable trouble in the form of recidivational attacks of fever, pain and dysuria. The extirpated part of the kidney with the cystic wall showed no evidence of tuberculous changes.

Case 5. M. L. Female. 30 years old.

For about 2 years the patient had been suffering from recidivation of dysuria. Urography revealed a combination of several developmental anomalies of the urinary tract. As mentioned above, in case 3, the renal pelvis was found to be somewhat irregular and blunt with very short pedicled calices on the opposite side. In the present case the right kidney is found highly hypoplastic, while on the left side the form of the kidney is normal. (Fig. 6.) In the upper renal pole there is a cavity about the size of a hazel nut resembling a cyst. The connection with the renal pelvis proper is long and narrow. (Fig. 7.) There is distinct retention in the cyst, and a roentgenogram taken about 15 min. after the rest of the renal pelvis had been emptied of contrast, shows the condition in the cyst to be approximately unchanged. (Fig. 8.) Chemotherapy had good effect in this case.

It seems reasonable to suspect the retention in the pyelogenic renal cysts of playing an essential part in the pyelitic recidivations, characteristic of the facies morbi of these patients. Also the formation of calculi might be considered to have some connection with this phenomenon. The rather frequent occurrence of calculi in ureterocele conditions should be remembered. Such findings have repeatedly been made at this hospital.

SUMMARY

The pyelogenic renal cysts must be regarded as developmental anomalies. Like the renal pelvis, calices and collecting tubules they originate in the duct of Wolff. Their characteristic qualities are described, and the fact that they are of no rare occurrence being especially emphasised. According to experiences from Oslo Municipal Hospital the pyelogenic cysts from a roentgenologic point of view must be described as the most common one of the renal cysts. In a material consisting of 30 cases of pyelogenic cysts of the kidney, calculi formation was found in half the number of cases. Six cases have been more closely described.

ZUSAMMENFASSUNG

Pyelogene Nierenzysten sind als Entwicklungsanomalien aufzufassen. Wie auch das Nierenbecken, die Nierenkelche und die Sammelröhrchen stammen sie vom Wolff'schen Gange. Ihre charakteristischen Eigenschaften werden beschrieben und der Umstand besonders betont, dass sie durchaus nicht selten vorkommen. Nach den Erfahrungen aus dem Städtischen Krankenhause in Oslo sind die pyelogenen Zysten vom röntgenologischen Gesichtspunkte aus die gewöhnlichste Form von Nierenzysten. In einem aus 30 Fällen von pyelogenen Nierenzysten bestehenden Material, wurden in der Hälfte der Fälle Steinbildungen gefunden. Sechs Fälle werden näher beschrieben.

RÉSUMÉ

Les kystes rénaux pyélogéniques doivent être considérés comme des anomalies de développement. A l'instar du bassinet rénal, des calices et des tubes collecteurs, ils ont leur origine dans le canal de Wolff. L'auteur décrit leurs traits caractéristiques et souligne spécialement le fait qu'ils ne sont pas une trouvaille rare. D'apres les expériences faites à l'Hôpital Municipal d'Oslo, il faut, du point de vue radiologique, regarder les kystes pyélogéniques comme représentant la majorité des kystes rénaux. Dans la moitié d'un matériel de trente cas de kystes pyélogéniques du rein on trouva des formations calculeuses. Six cas ont fait l'objet d'une description plus détaillée.

LITERATURE

ANDRESEN, K.: Röntgenpraxis. 1936.
ASK-UPMARK, E.: Acta Path. Scand. 36, 1929.
CARSON, W. J.: Ann. Surg. 1, 1928.
COLSTON, J. A. C.: Bull. Hopkins Hosp. 51, 1932.
DAMM ERDMANN: Z. urol. chir. 35, 1932.
GALKIN, W. S.: Z. urol. chir. 24, 1928.
HOWALD-LUDIN: Schweiz. med. Wochenschrift 11, 230, 1940.

Itikawa-Tanio: Z. Ur. 33, 732, 1941.
Krogius, Ali: Acta chir. scand. 64, 1929.
Köhler, H.: Z. Ur. 27, 1933.
Ljunggren: Z. Ur. 32—36—38—40.
Natvig, P.: Acta radiol. 22, 732, 1941.
Olsson, O.: Acta radiol. Supplement. XLVII.
Quinby-Bright: J. Ur. (Am.) 33, 201, 1935.
Randall, A.: Report from VII. Congress of Intern. Soc. of Urology. 1939.
Rudström, P.: Acta chir. scand. 85, 1941.
Steinert, R.: Acta radiol. Supplement. LIII.

FROM THE ROENTGEN-DIAGNOSTIC DEPARTMENT OF THE UNIVERSITY CLINICS
IN LUND, SWEDEN (CHIEF: PROF. H. HELLMER)

SUBDURAL HEMATOMA OUTLINED WITH AIR IN ENCEPHALOGRAM[1]

by

Olle Olsson

Chronic subdural hematoma can be diagnosed by encephalography and ventriculography, but no sign of this condition is pathognomonic when the ordinary methods are used for these examinations (ASK-UPMARK and INGVAR, BULL). Cerebral angiography permits a reliable specific diagnosis, showing the cerebral vessels removed from the cranial wall at the site of a hematoma (HEMMINGSON, ENGESET). Another pathognomonic sign, however, was described by DYKE in 1936. In an article entitled »A Pathognomonic Encephalographic Sign of Subdural Hematoma», he showed how a hematoma may be outlined by air in the subdural space. In his case air was injected into the lumbar subarachnoid space for encephalography. No air entered the ventricular system or cranial subarachnoid space. A moderate amount was seen in the subdural space, on the other hand, some beneath the tentorium, some beside the falx cerebri and, thirdly, »a large finger-like collection of air over the left cerebral hemisphere which projected diagonally, ventrally and laterally from the midline». The air was assumed to lie between the arachnoid and the inner membrane of a subdural hematoma. Operation verified the diagnosis.

No other similar case has been described since DYKE's report. LINDGREN concluded, therefore, that roentgenographic pictures of this kind, with air outlining the hematoma, were rare. Instead, in his experience, obliteration of the subdural space at the site of the hematoma was the rule. When air is present subdurally, he moves the patient so that the air is shifted toward the area of hemorrhage. In one case it proved to be impossible to get any air in the region of an oldstanding, later operatively verified hematoma.

[1] Submitted for publication, May 16, 1947.

Now a case will be described in which a small amount of subdural air was made to outline a hematoma by appropriate changing the position of the patient's head.

Case report

A farmer, aged 49. Medical record 2194.

Previous History. — Two months ago the patient fell off a bicycle and hit his head. He lost consciousness for a short while. He then remained well until a few days ago when he began to suffer from headache, gradually increasing and now severe, together with apathy and a roaring sound in his head. He could not open his right eye. The left leg was weak.

Examination. — The patient was confused and restless. His reactions were dull and slow and he yawned continuously. Ptosis of the right eyelid was observed, and reduced strength in the left leg. Examination of the eyegrounds revealed blurring of the disk edges, no measurable protrusion and normal veins.

Roentgen examination of the skull showed no injury to the bones.

On suboccipital puncture there was a rapid spontaneous flow of cerebrospinal fluid; the pressure was 230 mm. Sixty cc. of cerebrospinal fluid were replaced by air.

Encephalography. — The pellucid septum was displaced 2 cm. to the left of the midline. It lay slightly obliquely and together with the third ventricle it formed an angle opening toward the right. The entire right lateral ventricle was pushed in under the falx cerebri and the right inferior horn was displaced slightly medially. Air was present subarachnoidally over the left hemisphere and over the superomedial part of the right hemisphere; the sulci were of normal width. The greater part of the subarachnoid space over the right hemisphere, however, showed no filling. There was a moderate amount of air in the subdural space beneath the tentorium. The right tentorial dome bulged farther down than the left and its rostral portion bulged farther posteriorly than normally. A small amount of air was present in the subdural space over the convexity. By changing the position of the patient's head it was possible to make the air on the right side move lateralward. There it formed a slightly curved column, about 12 cm. long and 5 mm. wide at the widest point, with the concavity facing laterally. The lateral outline of the column was cleancut but the medial outline could not be distinguished from the airfilled sulci on the surface of the brain. Lateral to this scythe of air was a dense homogeneous area with a slightly convex medial outline; it had a maximum width of 5.5 cm. and a diameter of 12 cm. The observations were interpreted as a subdural hematoma on the right side.

Operation (Dr. Carlqvist). — A trephine opening 2 cm. in diameter was made over the right ear. The dura there was tense and reddened from underlying blood. On incision of the dura and the membrane of the hematoma, about 200 cc. of dark, liquid blood welled forth. The patient's mental condition cleared up during the operation.

Fig. 1. — Encephalogram. Frontal view in the sitting position. The pellucid septum is displaced 2 cm. to the left of the midline and the entire right lateral ventricle is pushed in under the falx cerebri. Air is seen in the subarachnoid space over the left hemisphere and superomedial part of the right hemisphere. Air has also collected subdurally under the tentorium and superomedially.

Encephalographic examination after suboccipital injection of air showed an expanding lesion in the right side of the cranial cavity. Air had collected in the subdural space. By moving the head the air was made to move to the site of the lesion which it surrounded medially. The expanding lesion was then seen to be situated in the subdural space and the specific diagnosis of subdural hematoma could be made.

This case presented much the same picture as that of DYKE. In our case, however, air had also entered the ventricular system, permitting the localization of a space-taking lesion. Examination of the subdural space, based on this observation, then led to the diagnosis.

It has been assumed that the cases which can be diagnosed in the manner just described are rare in number. The number of cases, however, is probably dependent upon the technic used for the examination, especially for the injection of gas. Thus there is only a small chance of the described picture when ventriculographic examination is used. On the other hand, there is a fairly large chance of obtaining a large or small subdural accumulation of gas when gas is injected suboccipitally for encephalographic study. This may happen if a long-bevelled needle is used, and a part of the opening faces the subdural space during the

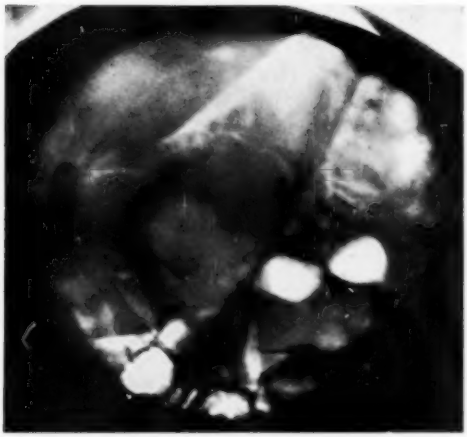


Fig. 2. — Encephalogram. Frontal view in the sitting position with the patient's head greatly flexed to the left. The air formerly situated superomedially has shifted lateralward. It now forms a scythe-like shadow where it fills a slightly curved space with a maximum width of 5 mm. Lateral to this scythe of air is the dense homogeneous shadow with a cleancut medial margin caused by the subdural hematoma.

whole puncturing procedure. It can also happen if the arachnoid is drawn in after a certain amount of fluid is withdrawn and the opening of the needle is thus brought partially or wholly into the subdural space.

When gas is injected by lumbar puncture this possibility is probably excluded for, as LINDGREN pointed out, the gas injected subdurally in the lumbar region does not as a rule pass over into subdural space of the cranium. In DYKE's case, where lumbar puncture was used, the air probably must have come into the subdural space in some other manner, perhaps through a communication between the subdural and subarachnoid space due to a rupture in the arachnoid. A rupture of this kind may have been caused by the absorption of the hematoma, particularly as the membrane of the hematoma may have become adherent to the arachnoid. As BULL and others have shown, the brain deformity caused by large subdural hematomas persists to a certain degree. Thus air filling of the subdural space several days after operative evacuation of a hematoma shows a large cavity still remaining. The brain does not follow the hematoma plastically. When absorption sets in in a large hematoma, it is very likely that adhesions between the inner membrane of the hematoma and the arachnoid will lead to rupture in the latter. The absorption also causes a space between the arachnoid and this membrane which becomes filled with cerebrospinal fluid. When the cerebrospinal fluid is withdrawn and gas is injected, the fluid there is replaced by gas. Absorption of the hematoma, accordingly, would explain the existence of the space between the hematoma and the brain surface and the characteristic roentgen picture.

DYKE's case was one of five cases of subdural hematoma examined ncephalographically. The present case is one of eight. A subdural col- ection of air under the tentorium was also observed in one of the other even instances but the examination had to be interrupted in this case s the patient became severely ill.

SUMMARY

A case of verified subdural hematoma is presented. Encephalography showed the presence of a local expanding lesion. By shifting the position of the head so that a subdural collection of air outlined the lesion, it was shown to be a subdural hematoma. The author suggests that this pathognomonic encephalographic picture is due to absorption in the hematoma.

ZUSAMMENFASSUNG

Es wird über einen Fall von verifiiertem Subduralhämatom berichtet. Enzephalographie wies das Vorliegen eines lokal raumbeschränkenden Vorgangs nach. Durch Lageänderung des Kopfes, so dass eine subdurale Luftblase die Grenzen des Prozesses zeigte, wurde nachgewiesen, dass es sich um ein Subduralhämatom handelte. Verf. spricht die Vermutung aus, dass dieses pathognomonische enzephalographische Bild durch Absorption im Hämatom bedingt ist.

RÉSUMÉ

Présentation d'un cas, vérifié, d'hématome sousdural. L'encéphalographie montrait la présence d'une lésion locale expansive. En faisant varier la position de la tête, ce qui révélait qu'une collection gazeuse sousdurale circonscrivait la lésion, on prouva qu'il s'agissait d'un hématome sous-dural. L'auteur émet l'hypothèse que cette image encéphalographique pathognomonique est due à une absorption dans l'hématome.

BIBLIOGRAPHY

ASK-UPMARK: Nord. Med. 8: 2357, 1940.
BULL: Proc. Roy. Soc. Med. 33: 203, 1940.
DYKE: Bull. Neurol. Inst. New York 5: 135, 1936.
ENGESET: Acta radiol., Oslo, 1944, suppl. 56.
HEMMINGSON: Acta radiol. 20: 499, 1939.
INGVAR and ASK-UPMARK: Acta med. Scandinav. 94: 225, 1938.
LINDGREN: Acta radiol. 23: 368, 1942.
—, Nervenarzt, 14: 193, 1941.

HAVE YOU SUBSCRIBED TO THE

ACTA RADIOLOGICA?

The ACTA RADIOLOGICA, published by the Radiological Societies of Denmark, Finland, Holland, Norway, Sweden, and Switzerland, contain original articles on roentgen diagnostics and radiotherapy, in English, French or German, every article being furthermore supplemented with summaries in all those three languages. Each volume contains about 500 pages published in six numbers and is richly illustrated. So far, 28 volumes and 67 supplementary volumes have been published.

Subscription rate: Swedish Crowns 35.— postage for non-Scandinavian countries, 3 Sw.Crowns additional. Single copies 7 Swedish Crowns plus postage.

EDITOR:

GÖSTA FORSSELL, M. D.

NO RADIOLOGIST CAN GET ALONG WITHOUT THE

ACTA RADIOLOGICA

Subscription through *Acta Radiologica, Stockholm 2* (Sweden) or through the booksellers.

FROM THE ROENTGEN DEPARTMENT, GENERAL HOSPITAL MEDICAL POLICLINIC, HELSINGFORS (CHIEF PHYSICIAN: CARL WEGELIUS, M. D.)

SCREEN PHOTOGRAPHY EQUIPMENT FOR EASIER DETAIL PHOTOGRAPHY WITH ROUTINE ROENTGEN DIAGNOSIS WORK[1]

by

Carl Wegelius and *Kaj Noschis*

Up to the present the equipment used in routine screen photography of the thorax has consisted of very bulky special apparatus. In the equipment hitherto in use, the distance between the camera and the fluorescent screen has been at least one metre, making the light-protecting tubes altogether too heavy and cumbersome to be easily combined with an apparatus used in ordinary fluoroscopy. Separate apparati, independent of each other, have therefore had to be used for fluoroscopic and screen photographic examinations, with the result that it has not been possible for suspect details, observed in fluoroscopic examination, to be fixed immediately by exposure on a film, as is the case in the usual combined fluoroscopy and roentgenography.

A further disadvantage when using the present screen photography equipment for detail examination is the very great reduction in size which the image visible on the fluoroscopic screen undergoes in screen photography. When so-called cine-film, size 35×35 mm is used, the reduction ratio is 1: 16.7 and when using the so-called large size, viz., 80×80 mm, it is still as much as 1: 5.7. Pictures obtained in this way are consequently not suited for detail examination and the use of this type of screen photographic apparatus for such purpose is not successful, even though the technical arrangements for rapid change from the ordinary roentgenography to screen photography equipment could be made more convenient and speedy.

However, the use of screen photography technique in detail roentgenography would in itself be theoretically desirable and certainly

[1] Submitted for publication, Oct 3, 1946.

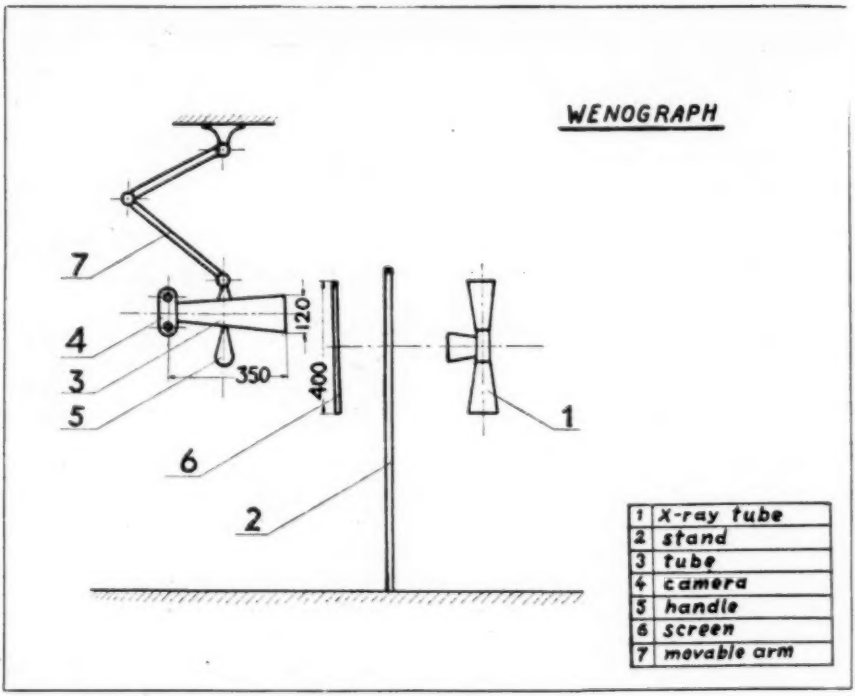


Fig. 1.

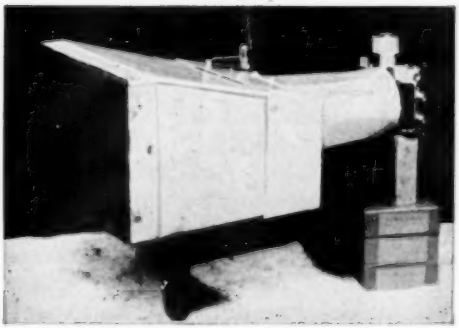


Fig. 2.

Fig. 1. Diagram showing the Wegnograph, its various component parts and dimensions, its application and relation to standard roentgen apparatus for fluoroscopy and photography.

Fig. 2. Showing the Wegnograph detached from its position in the roentgen apparatus.

very practical in many respects. On the one hand, the screen photography technique allows of a repeated and rapid sequence of exposures without any changing of the film cassette, which can be of practical significance *i. a.* when examining the motility and changes in shape and size of motile organs (*e. g.* oesophagus, stomach and gut). Again, it is often desirable to have a detail photograph of the pathological changes in one section of some larger organ, the condition and development of which can be fixed in this documentary way, thereby facilitating later comparative examinations. Instances of this kind are top of the lung or other localized changes in lung conditions, niche by peptic ulcer in the stomach and duodenum, size and position of calcified concrements in internal organs and so on. At least in most European countries advantage cannot at present be taken of such opportunities of more frequent control, as financial straits and actual lack of films necessitate very sparing use of photography and compel its substitution to a great extent by fluoroscopy. The cost of a screen photograph is, however, so much less than that of an ordinary, direct roentgenogram on large size film, that it certainly can be surmounted in many instances where photography has hitherto not been possible, owing to the expense of the usual technique.

To eliminate both the above-mentioned disadvantages (too large, inconvenient size and too great reduction of the visible image) entailed by the present form of screen photography technique, the authors have constructed an apparatus much smaller in size and weight, which therefore can easily be employed during fluoroscopy. It is ready for instantaneous exposures and further gives substantially smaller reduction in size of the image, thus affording correspondingly greater possibilities of effective detail examination. This apparatus, which by combining the first letters in the surnames of the authors has been called Wegnograph, shows the following characteristics: —

1) The distance between the fluorescent screen and the film plane of the camera has been reduced to 350 mm., the optics of the camera having been corrected accordingly.
2) The size of the photographed screen-area has been reduced to 120 × 120 mm.
3) When using a 35 × 35 mm. cine-film in the camera, the reduction in size of the image is 1:5 (*i. e.* less than the reduction 1:5.7 by the so called large size screen photography on 80 × 80 mm. film).
4) The apparatus, being easily hung on ball-bearings alongside the fluorescent screen, is ready for immediate use. The ordinary fluorescent screen is used, the apparatus being pressed direct

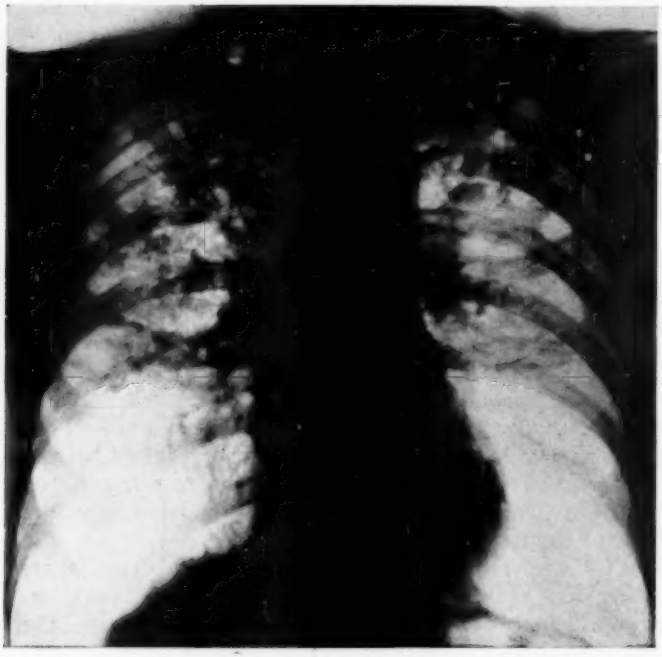


Fig. 3. Standard roentgenogram of thorax, shown in reduced scale 1 : 4.

Fig. 4. Standard roentgenogram of stomach, shown in reduced scale 1 : 4.

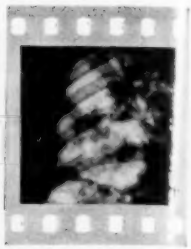


Fig. 5.

Fig. 6.

Fig. 5—6. Screen photography, showing pathological details of the cases reproduced in Figs. 3 and 4, taken with Wegnograph and here reproduced in natural size. Note how plainly the pathological details are visible in this moderate reduction 1 : 5. Using the ordinary screen photography technique (reduced scale 1 : 6,7) it would obviously not be possible to differentiate the corresponding parts without having recourse to an enlarging projection procedure.

against same when an exposure is to be made. The fluorescent shadow image is thus fixed on the film in the ordinary way. The method presupposes the use of roentgenological exposure values of the kind commonly used in screen photography, while in addition the use of a sensitive fluorescent screen with grid, both superior in all respects, is a sine qua non.

5) The exposure takes place by instantaneous release, managed by the examiner *himself* in the way usual in instantaneous photography of *e. g.* the duodenum.
6) Including the camera, the apparatus weighs only 2 kilograms and measures altogether about 40 × 15 × 15 cm. Its transport and fitting for exposures is therefore very easy, as likewise its removal, when ordinary fluoroscopy is to be resumed.

In the illustrations overleaf the relations between ordinary, direct roentgenography, the screen photography hitherto in use and screen photography with the Wegnograph are shown. Attention is drawn to the far smaller degree of image reduction when the Wegnograph is used, affording much better possibilities of detail examination of parts undergoing pathological changes. Its use in single and repeated control photographs of particular, clinically important parts of internal organs seems to be worth recommending. The sharpness of the image is the same as in good screen photography in general, *i. e.* not much inferior to an ordinary roentgenogram.

SUMMARY

The Wegnograph, a screen photography apparatus for easy detail photography in routine Roentgen diagnosis work, is characterized by small size and light weight, by a smaller degree of reduction than in ordinary screen photography and by immediate readiness for use with an ordinary screen. The Wegnograph is especially adapted for photography of particular pathological changes of the internal organs in cases where rapid action, possibilities of repeated exposures on the same occasion or during a later control and lower cost as compared with direct roentgenography are called for, while at the same time documentary fixation is requisite.

ZUSAMMENFASSUNG

Eine Wegnograph genannte Schirmbildaufnahme-Ausrüstung für Röntgen-Detailabbildung in der routinemässigen Diagnostik, welche gekennzeichnet ist durch geringes Gewicht, gedrängten Bau und eine geringere Bildverkleinerung als bei den bisher für Schirmbildaufnahmen verwendeten Typen sowie auch dadurch, dass sie bei Verwendung eines gewöhnlichen Durchleutungsschirmes jederzeit unmittelbar gebrauchsfertig ist. Der Wegnograph eignet sich besonders für die Aufnahme von einzelnen pathologischen Partien in Fällen, wo ein schnelles Eingreifen und Möglichkeit der Wieder-

holung bei derselben Gelegenheit oder später zwecks Kontrolle zu niedrigen Kosten wünschenswert sind und wo ein Bedürfnis einer dokumentierenden Bildfixation vorliegt.

RÉSUMÉ

Le »Wégnographe», appareil radiophotographique destiné à la photographie courante des détails dans le travail de diagnostic radiologique de tous les jours, est caractérisé par sa légèreté, son faible volume, un moindre degré de réduction des images en comparaison de ce qui se fait jusqu'ici en radiographie, et enfin par la possibilité de l'utiliser instantanément avec un écran ordinaire. Le Wégnographe est particulièrement bien adapté à la photographie de segments pathologiques isolés des organes internes quand une action rapide est nécessaire, et il offre la possibilité de répéter les expositions, soit dans les mêmes conditions, soit lors d'un contrôle ultérieur. Il diminue la dépense par rapport aux radiographies directes, là où l'on a un égal besoin de documents photographiques.

FROM THE ROENTGEN-DIAGNOSTIC DEPARTMENT OF THE UNIVERSITY CLINICS
IN LUND, SWEDEN (CHIEF: PROF. H. HELLMER)

ON THE TECHNIC OF LUMBAR PNEUMOMYELOGRAPHY[1]

by

Olle Olsson

Disk prolapses have long been known as a pathologic phenomenon, mainly due to SCHMORL's investigations. Not until 1934, however, did MIXTER and BARR point out that this condition to a great extent could be responsible to root pain of the sciatica type by compressing the nerve roots. Their observation started intensive research on the causes of sciatica and ways to treat it surgically. To begin with, the diagnosis of disk prolaps was based largely upon myelographic observations. In 1939, however, SPURLING and BRADFORD suggested that the niveau diagnosis of the condition might be established clinically. These authors assumed that with increased understanding of the neurologic picture myelography would be unnecessary. DANDY agreed later and pointed out that, because disk prolapses were most common in the lower lumbar spaces, surgical exploration could be used instead of myelography. SJÖQVIST and NORLÉN have done valuable work in the elaboration of an exact clinical niveau diagnosis.

Experience has shown, however, that clinical examination sometimes only results in the suspicion of disk prolaps, myelography being necessary to ensure the diagnosis and show the level of the lesion. As long as myelography remains a harmless method of examination, it is certainly as a rule preferable to the surgical exploration advocated by DANDY.

Myelography for the diagnosis of lumbar disk prolapses can be done with contrast agents which give a positive or negative contrast. The medium first used for the purpose, iodized oil (lipiodol, iodipin etc.), is retained and sometimes causes arachnoiditis hindering later operations (LINDGREN) and giving clinical distress. Tapping the oil by trephination of the sacrum at the lowest point of the spinal canal after the examination (LINDBERG) no doubt diminishes these risks but does not completely re-

[1] Submitted for publication, May 16, 1947.

move the medium. Iodized oil is now no longer used for this form of examination.

NICHOLS and NOSIK suggested using thorotrast in 1940. This medium, as LEKSELL pointed out, may irritate the meninges and give rise to arachnoiditis.

Another contrast medium, ethyl iodophenylundecylate, marketed under the name of Pantopaque, has been used in U. S. A. during recent years. This agent offers no advantages to speak of; it is too viscid to fill out the root pockets completely and it is very slowly absorbed.

ARNELL reported his experience with Abrodil in 1944. This agent was suggested for myelography by ARNELL and LIDSTRÖM as early as 1931. The method for its use in the diagnosis of disk prolaps has been elaborated particularly by LINDBLOM and is now employed to a wide extent in Sweden. Reports at the meetings of the Swedish and Northern Associations for Medical Radiology have shown, however, that the method has definite disadvantages, because of the risks incurred in combining a hypertonic contrast agent with spinal anesthesia. When more experience has been gained, however, and the method has been improved, it should without doubt mean an advance in this field. A positive contrast medium is preferable from an optic-physiologic standpoint. But the ill effects and risks they incur are large and we are still waiting for the ideal positive contrast medium to be found.

For the present we must keep to the agents which give negative contrast, the gases, if we are to use harmless methods. As regards the gaseous contrast agents, sterile oxygen heated to body temperature has proven very satisfactory. It has such insignificant side effects and is so easy to handle, that experimentation with other gases is without interest. The disadvantages of using gas are

1. the slight contrast
2. the long time required for the examination
3. the ill effects after the examination

We have made attempts to eliminate the first disadvantage by using tomographic examination. However, the difficulty in finding the right layer rapidly and the strain on our tomographic laboratory forced us to abandon this method. The technic now to be described is that of BUSCH and LINDGREN modified so as to avoid as far as possible the three disadvantages just mentioned. It is as follows:

The lumbar puncture is carried out on the wheeled stretcher on which the patient is taken from the ward to the roentgen-diagnostic department. Thus it can be done in a waiting cubicle or any other suitable place, leaving the roentgen laboratory free for other purposes during the long time necessary for tapping out the cerebrospinal fluid. The p-

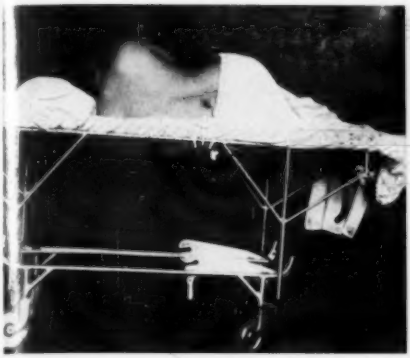


Fig. 1 a.

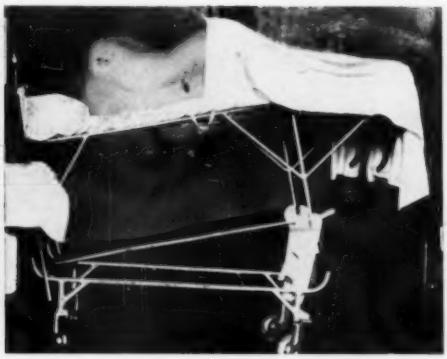


Fig. 1 b.

Fig. 1 a. — The lumbar puncture and withdrawal of cerebrospinal fluid are done on the wheeled stretcher on which the patient is transported to the roentgen department. This part of the examination can be done in any place at all that is suitable, leaving the roentgen laboratory free for other purposes in the meanwhile.

Fig. 1 b. — When a sufficient amount of cerebrospinal fluid is withdrawn, the foot end of the stretcher is elevated by the simple appliance shown in the figure. The gas is then injected and the pictures taken with the rays directed horizontally. Crossed Lysholm grids, placed upright at the back of the patient, are used.

tient lies on a firm surface in the lateral recumbent position with the healthy side down, *i. e.*, with the sciatica side up (fig. 1 a).

When sufficient cerebrospinal fluid has been withdrawn, generally 30—40 cc., the foot end of the stretcher is raised. The stretcher is fitted with a simple appliance for tilting one end (fig. 1 b). The original reason the stretchers were constructed in this manner was to enable the patient to be kept at the desired angle while he was being transported back to the ward after the examination.

The gas is injected with LINDGREN's apparatus. We generally maintain the gaseous pressure at 300 to 400 mm. of water. Positive pressure of this degree causes the desired distention of the subarachnoid space without involving any risk of rupture. The patient usually gets a numb feeling in the sciatica leg when this pressure is used. On the other hand, the pressure is not allowed to reach such a degree that a cramp develops in the leg.

The roentgenograms are taken with the patient in the lateral position, and thus with the rays directed horizontally. Pictures are taken both in the purely lateral position and with the upper part of the body bent backward in different degrees. The lateral position enables better filling

Fig. 2 a. Fig. 2 b. Fig. 2 c. Fig. 2 d.

Fig. 2 a and b. — Disk prolaps in the fourth lumbar space.
Fig. 2 c and d. — Disk prolaps in the fifth lumbar space.

of the root pockets and does not require much moving of the patient. Another advantage is that any tube can be used. Thus one is not forced to use a certain laboratory, a certain examining table or a certain roentgen tube.

Secondary screening is effected by means of two Lysholm grids placed at right angles to one another. In addition to filling this purpose admirably, the crossed grid has another decided advantage: The most disturbing factor in the interpretation of a pneumomyelogram is the structure of the vertebral body. When a crossed grid is used, the irregular vertebral body structure is replaced to a large extent by a regular network from the grids, against which the gas can easily be seen. Consideration must naturally be given to the direction of the grid when angulating the tube, but slightly oblique projections are also possible with the crossed grid.

With this method the root pockets are well visible and also in many cases the roots themselves, normal or thickened.

The patients are remarkably little affected by the examination, much less than by methods used previously according to clinical reports. This is probably because of the relatively low positive pressure used and the few changes to be made in the position of the patient.

The limitation of the method lies in the relationship between the normal anatomy of the subarachnoid space and the pathologic anatomy of the disk prolaps. All the contrast agents used now, both positive and

negative, have this limitation. Attempts at epidural injection of contrast medium (KNUTSSON, LEKSELL, LINDBLOM, LINDGREN) and injection of medium directly into the nucleus pulposus (LEKSELL, LINDBLOM) have not led to acceptable results. A perfect method of examination probably is not obtained until it will be possible to perform neurography.

SUMMARY

The author describes a simple method for performing lumbar pneumomyelography. The examination is made with the patient in the lateral position on a simple wheeled stretcher, using horizontally directed rays and crossed Lysholm grids.

ZUSAMMENFASSUNG

Verf. beschreibt eine einfache Methode zur Ausführung der lumbalen Pneumomyelographie. Die Untersuchung wird am seitlich liegenden Patienten auf einer einfachen Bahre auf Rädern unter Verwendung von horizontaler Strahlenrichtung und gekreuzten Lysholm'schen Gittern vorgenommen.

RÉSUMÉ

L'auteur décrit une méthode simplifiée de pneumomyélographie lombaire. L'examen se pratique sur le malade en décubitus latéral sur un simple brancard roulant, les rayons sont dirigés horizontalement et l'on se sert de la grille en croix de Lysholm.

BIBLIOGRAPHY

ARNELL: Acta Radiol. 25: 408, 1944.
ARNELL and LIDSTRÖM: Acta Radiol, 12: 287, 1931.
BUSCH: Acta Radiol. 12: 556, 1941.
DANDY: J. A. M. A. 117: 821, 1941.
FRIBERG: Acta chir. Scandinav. LXXV, 1941, suppl. 64.
KNUTSSON: Acta Radiol. 22: 694, 1941.
LEKSELL: Nord. Med. 20: 2453, 1943.
LINDBLOM: Acta Radiol. 31: 1, 1946.
—, Nord. Med. 30: 1173, 1946.
LINDGREN: Acta chir. Scandinav. 82: 303, 1939.
—, Radiol. Clin. 10: 337, 1941.
MIXTER and BARR: New England J. Med. 211: 210, 1934.
NICHOLS and NOSIK: Radiology 35: 459, 1940.
NORLÉN: Acta chir. Scandinav. XCI, 1944, suppl. 95.
SJÖQVIST: Nord. Med. 13: 687, 1942.
STERLING and BRADFORD: J. A. M. A. 113: 2019, 1939.

AUS DEM UNRRA D. P. HOSPITAL TEAM 1017 (DIREKTOR: DR. VANDEVELD, UNRRA-CHIEF-MEDICAL OFFICER, HEILBRONN, GERMANY)

ÜBER EINEN INTERESSANTEN FALL VON MÉLORHÉOSTOSIS[1]

von

Dr. *E. Fejér*, Chefarzt der Röntgenabteilung

Diese eigenartige Knochenkrankheit wurde bisher in sehr wenigen Fällen beobachtet und zuerst im Jahre 1922 durch Léri und Joanny beschrieben. Die verschiedenen Autoren nennen sie Mélorhéostosis, Osteosclerosis, Osteopathia hyperostotica, Flowing monomelie Hyperostosis. Die Krankheit ist nur durch die Röntgenuntersuchung diagnostizierbar und äussert sich in einem ganz typischen mit anderen nicht verwechselbaren Bildern. Ein osteosclerotischer Streifen durchzieht alle Knochen der kranken Extremität. Das Leiden wurde bisher immer nur an Knochen der Extremitäten beobachtet, doch können auch die Knochen der Schulter und des Beckens ergriffen sein.

Léri und Joanny beschrieben das Aussehen des Knochens und vergleichen es mit einer Kerze, an welcher das »geschmolzene Wachs herunterläuft». Dieser Vergleich ist gut. Man hat das Empfinden, als wenn die Knochensubstanz an dem Knochen heruntergeflossen wäre und so Verdichtungen verursacht. Doch können Verdichtungen auch im Inneren des Knochens, in der Markhöhle entstehen. Es handelt sich daher wahrscheinlich nicht nur um eine Periostitis ossificans, sondern auch um eine Markproliferation. Die Verdichtungen scheinen dort zu entstehen, wo die Nahrungszufuhr am besten ist, also in der Gegend der Art. nutritiae. Das Röntgenbild ist jedenfalls so charakteristisch, dass es mit keiner anderen Knochenkrankheit verwechselt werden kann. Da besonders an den Gelenken die Knochenauflagerung unregelmässig und die äussere Fläche rauh sind, können bei Bewegung der Gelenke Schmerzempfindungen entstehen und die Beweglichkeit der Gelenke kann eingeschränkt werden.

Diese Knochenkrankheit wird meistens nur bemerkt, wenn der sich ausbreitende hyperostosische Prozess Rauhigkeiten verursacht und

[1] Bei der Red. am 10. V. 1947 eingegangen.

dadurch Schmerzen oder Bewegungsstörungen hervorruft. Die Krankheit soll nach KÖHLER im Kindes- oder Wachstumsalter beginnen.

Die Krankheit ist sehr selten. CAFFEY erwähnt nur 2 Fälle, bei einem 5- und einem 19-jährigen Kranken. KÖHLER gibt die gesamte Literatur an, es sind im ganzen nur 20 Fälle. Bei Säuglingen und Kindern unter 5 Jahren wurde die Krankheit noch nicht beobachtet.

Durch welche Ursachen sie hervorgerufen wird, ist unbekannt. Hypothesen gibt es natürlich. So meint PUTTI, dass sie auf eine Erkrankung des sympatischen Nervensystem zurückzuführen sei. Da durch die Krankheit die Knochen eine Verlängerung erfahren, hat diese Theorie manches für sich. LÉRI betont ausdrücklich, dass in seinem Falle das Nervensystem unversehrt war und die Knochenverdickung weder den Nerven noch den Verlauf der Gefässverzweigungen entsprechend entwickelt waren. ZIMMER meint, dass die Krankheit eine angeborene Grundlage hat, und das Ursegment, welches die Extremität bildet, schon ursprünglich fehlerhaft angelegt sei. MOORE und LORIMIER glauben, dass die einseitigen regionalen subperiostalen Teleangiektasien für diese krankhafte Knochenbildung verantworlich seien.

Amerikanische Autoren denken an vasomotorische Störungen auf der Grundlage kleiner Infekte oder unbekannter endokriner Faktoren. (CAFFEY.)

Meine eigene Beobachtung ergibt folgendes Bild:

Dr. B. R. 30 Jahre alt. Familienanamnese ohne Besonderheiten. Eigen-Anamnese: Scarlatina mit 5 Jahren, Morbili mit 7 Jahren, Im Kindesalter mehrmals Bronchopneumonie, im 15. Lebensjahr wegen gutartiger Geschwulst im Kniegelenk operiert. Er erlitt vor 10 Jahren bei einem Autounfall eine Schädelbasisfractur und Fracturen der Querfortsätze aller fünf Lendenwirbel, mit Nierenquetschung. Wurde 9 Monate lang behandelt. Im Kindesalter häufig Heuschnupfen, der sich fast jährlich wiederholte. Im 22. Lebensjahr Appendectomie, 1943 verwundet, glatter Durchschuss des linken Oberschenkels, und Gehirnerschütterung. Vor 3 Jahren Cholecystitis acuta.

Jetzige Erkrankung: 1938 wurde bei einer Röntgenuntersuchung der linken Hand zufällig eine erbsengrosse Verdickung am Ringfinger entdeckt und für eine Exostose gehalten. Nach 4 Jahren (1942) wurde der linke Arm röntgenologisch untersucht und dabei das heute vorliegende Bild gefunden: Knochenverdichtungen an der linken Extremität von der Schulter bis zur Fingerspitze. Die Krankheit wurde damals nicht als Mélorhéostosis erkannt. Diagnose lautete: Knochensystemerkrankung unklarer Herkunft. Abb. 1—3. Behandlung: keine. Er wurde langere Zeit in einem Kriegslazarett behandelt, wo die Blutuntersuchung einen herabgesetzten Calciumspiegel ergab. Jetzt kam er zur Untersuchung, weil er in den letzten Monaten geringe Beschwerden hatte, die früher nicht vorhanden waren; leichte Schmerzen, die besonders nach Anstrengung des Armes im Ellenbogengelenk bei Supination u. Pronation auftraten. Die einzelnen Knochen sind verschieden druckempfindlich, am stärksten bei Druck am Ellenbogengelenk. Status: 166 cm. gross, 73.5 kg. Mann in gutem Ernährungszustand. Schleimhäute normal, Lymphdrüsen nicht tastbar, Herz und Lungen o. B. Blutdruck 105/65 Hg mm RR. Nervensystem und Reflexe normal.

Abb. 1. Abb. 2.

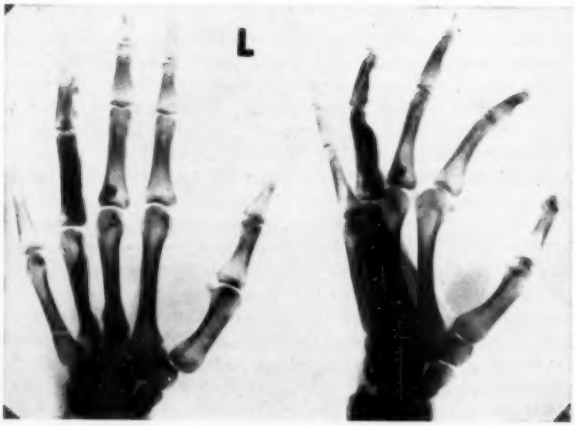


Abb. 3.

Die Röntgenaufnahme der linken oberen Extremität zeigt Knochenverdichtungsherde, die den Vergleich von »herunterläufendem Wachs an einer Kerze« zulassen, und mit der Längsachse des Knochens parallel verlaufend, die ganze Breite des Knochens einnehmen. Teilweise ist die Knochenmarkhöhle verschwunden. Befallen sind die Röhrenknochen.

Laboratoriumsuntersuchungen: Blutkörperchensenkung 3/6 mm. n. W. Blutbild: Hb. 96 %, Erythro. 5,050,000, Leucocythen 6,000, Segment 62 %, Stab. 3 %, Eo. 5 %, Lympho. 27 %, Mono. 3 %.

Serumcalcium zeigte einen leicht herabgesetzten Wert: 8 mgr. %. Der Fall ist besonders dadurch interessant, dass der Kranke 2 Jahre vor der Feststellung der Knochenkrankheit eine Schädelbasisfraktur erlitt.

Meiner Meinung nach ist es möglich, dass das erlittene Schädeltrauma in kausalem Zusammenhang mit der beschriebenen Knochenkrankheit steht. Aus der Literatur (H. H. Meyer) ist der Zusammenhang zwischen Stammhirn und Schilddrüse bereits bekannt. Die Verletzungen des Stammhirnes können Basedowsyndrome auslösen. Es ist leicht vorstellbar, dass die Verletzung des Stammhirnes die Calciumstoffwechselregelung, welche durch die Parathyreoida gelenkt wird, in Richtung einer Dysfunktion beeinflussen.

Leider fehlen die exakte Anamnese und der neurologische und enzephalographische Befund nach dem Schädeltrauma. Es ist doch nicht ausgeschlossen, dass dieses Trauma der ursächliche Faktor der Knochenkrankheit war.

Es wird vorgeschlagen, bei Mélorhéostosis weiterhin in dieser Richtung zu forschen.

ZUSAMMENFASSUNG

Es wird über einen Fall von Mélorhéostosis des linken Armes berichtet. Dies ist der 26. Fall in der gesamten Weltliteratur. Nach kurzer Erwähnung der verschiedenen Hypothesen über die Genese dieser Erkrankung wird als wahrscheinliche Entstehungsursache ein früher stattgehabtes Schädeltrauma angenommen, das zu einer Verletzung des Stammhirnes geführt hat und in dessen Relation zur Parathyreoidea zu einer Disfunktion derselben gekommen ist, sodass sich hieraus das Krankheitsbild entwickelte. Es wird empfohlen, bei Mélorhéostosis auf Schädeltraumen besonders zu achten.

SUMMARY

A case of melorheostosis is reported, which affected the left arm. It is the 26th case, when computed on the basis of the entire medical literature. The various hypotheses advocated as to the process of originating of this disease are reviewed. The author points to a potent trauma previously sustained and located to the skull, having entailed an injury of the cerebral trunk. A dysfunction of the parathyroid, related to that intracranial injury, has secured evidence of the findings stated. The author lays emphasis on the importance of traumata of the skull in melorheostosis.

RÉSUMÉ

Relation d'un cas de Mélorhéostéose du bras gauche. C'est le 26e de la bibliographie mondiale. Après avoir brièvement rappelé les diverses hypothèses touchant la pathogénie de cette affection, l'auteur admet, comme cause vraisemblable, un traumatisme cranien précédent ayant entraîné une lésion du tronc cérébral, et, de par les connexions de cette région avec les parathyroïdes, créé une dysfonction de celles-ci, ce qui aurait permis le développement du tableau clinique. Il recommande, en cas de Mélorhéostéose, d'avoir son attention particulièrement attirée sur les traumatismes du crâne.

LITERATUR

1. J. Caffey, J. A. B., Pediatric X-ray diagnosis. The year book publishers JNC Chicago. 1945. 631.
2. Köhler, A., Grenzen des Normalen und Anfange des Patologischen im Röntgenbilde. Georg Thieme, Leipzig. 1943. 13.—14.
3. Hajós, K., A belsö secretiós betegségek, Magyar Orv. Könyvkiad. Társ Budapest. 1935.
4. H. H. Meyer. Das Basedow-Syndrom nach Schädeltraumen. Deutsch. Med. Wochenschr. 1946. Juli. 84—85.

FROM THE ROENTGEN-DIAGNOSTIC DEPARTMENT OF THE UNIVERSITY CLINICS IN LUND, SWEDEN (CHIEF: PROF. H. HELLMER)

ACCIDENTAL EXTRAPLEURAL PNEUMOTHORAX[1]

by

Olle Olsson

After several research workers' observations of the beneficial effects of lung collapse in pulmonary disease, Forlanini presented his method for intrapleural pneumothorax in 1882. Not until after the turn of the century, however, after the development of roentgenographic diagnosis and asepsis, did it begin to enjoy the wide use it does today, especially for pulmonary tuberculosis.

During the course of initiating or maintaining an artificial pneumothorax, the parietal pleura may be stripped from the chest wall and smaller or larger quantities of gas be deposited extrapleurally. Considering the extensive use of collapse therapy and the anatomic conditions, *accidental extrapleural pneumothorax* (Oechsli) of this nature is probably a fairly common occurence. It is remarkable, therefore, what a long time elapsed before the condition was observed and how many are still unaware of its existence.

The Italian, Corbetta, was the first to draw attention to the condition in a case published in 1933. Other Italian authors have since made similar observations. Thus in 1934 Faravelli reported 4 cases of the condition in 400 cases of pneumothorax. In 1936 Filla gave a detailed description of one case, and in 1938 Omodei Zorini described two cases in which an extrapleural pocket had arisen after the insertion of a heavy thoracoscope. In 1940 d'Angelo reported as many as twenty-five cases in a large investigation published in the annals of the Forlanini Institute.

These first reports in the Italian literature were apparently not noticed in other countries. When Davy and Rolland reported three cases and Lowys one case in the French Revue de la Tuberculose in 1938, they did not know about the previous Italian reports. Likewise, a later American report on accidental extrapleural pneumothorax by

[1] Submitted for publication, May 20, 1947.

Oechsli mentions the French but not the Italian reports. Oechsli's report covers 15 cases observed among over 400 pneumothorax cases.

As mentioned, the occurence of extrapleural pneumothorax during the course of collapse therapy is not generally known of. Since, in addition, the condition may be of much greater practical importance than realized hitherto, I shall now describe seven cases which I have observed during the past two years.

Case Reports

Case 1. — A woman, aged 20. Clinical record 196/44. Tuberculosis of left lung. Artificial pneumothorax.

The patient had been undergoing pneumothorax treatment for tuberculosis in the left lung for two years without any complications. On routine examination on Sept. 21, 1944 the pneumothorax cavity was found to be very narrow and the lung partly adherent to the chest wall. Only small amounts of air could be introduced. A large refill was made in order to get the lung free.

Roentgen examination on September 21 showed that the left lung was completely separated from the chest wall and well collapsed. Lateral to the middle of the collapsed lung was a walnut-sized gas-filled cavity, and over the apex another long narrow one, separated from the pleural cavity by only a thin membrane. Posteriorly and laterally in the middle of the thoracic cavity was a third gas-filled cavity lying along the chest wall and circumscribed by a membrane bulging out from the wall. This cavity was 15 cm. long and 2 cm. wide at the widest point. The cavities were recognized as extrapleural and subpleural pockets formed in connection with artificial pneumothorax. (Fig. 1 a.)

Roentgen examination on April 23, 1945 showed that the subpleural accumulation of gas had entirely disappeared and that the extrapleural pocket had diminished greatly in size. (Fig. 1 b.)

On re-examination November 12 the extrapleural pocket had vanished. At its site was a narrow pleural thickening along the chest wall.

Case 2. — A woman, aged 43. Clinical record 583/44. Bilateral pulmonary tuberculosis. Bilateral artificial pneumothorax.

Pneumothorax was induced on the right side in 1940 and on the left side in 1941. The patient had been undergoing ambulant treatment with a refill on the right side every second week and one on the left side every sixth week.

On routine *roentgen examination* on April 5, 1944 the following was noted: The left lung was only slightly collapsed and showed thickening of the pleura at the base. Along the lateral chest wall was a gas-filled, column-shaped cavity crossed over by adhesions and separated from

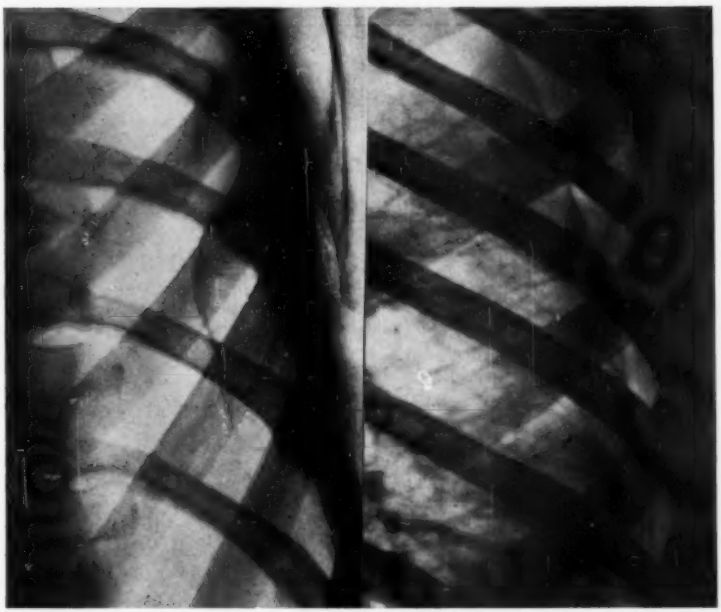


Fig. 1 a. Fig. 1 b.

Fig. 1 a. Case 1. Lateral and posterior to the middle of the pneumothorax cavity is a membrane bulging out 2 cm. at the maximum from the chest wall, enclosing an extrapleural gas-filled pocket.

Fig. 1 b. Case 1. Seven months later. A small remainder of the extrapleural accumulation of gas is still seen.

the pleural cavity by a membrane one or two millimeters thick bulging out from the chest wall. The cavity was 13 cm. long and 1 cm. wide at the maximum. Its upper limit was situated near the top of the thoracic dome. (Fig. 2.)

Later examinations showed that the cavity had diminished in size but most of it was still present two years later.

The observations were interpreted as an extrapleural column of air separated from the pleural cavity by a thickened parietal pleura and probably communicating directly with the intrapleural pneumothorax cavity.

Case 3. — A man, aged 20. Clinical record 313/46. Bilateral pulmonary tuberculosis. Bilateral artificial pneumothorax.

Pneumothorax was induced on the left side in 1944 and on the right side in 1945. Refills were given every second week.

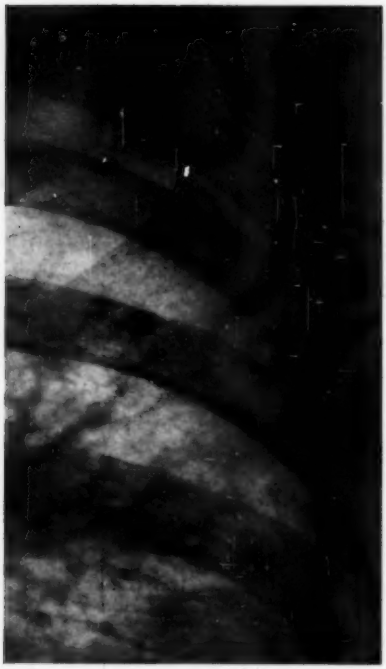


Fig. 2. Case 2.

Along the superolateral part of the chest wall is a gas-filled column. The column is circumscribed medially by a 1—2 millimeter thick membrane bulging out from the chest wall and formed by the partially detached, thickened parietal pleura.

Routine *roentgen examination* on April 14, 1945 showed moderate collapse of the left lung. Along the lateral chest wall was a columnar collection of air separated from the pleural cavity by a millimeter-wide membrane bulging out from the chest wall. The cavity was 14 cm. long and 1 cm. wide at its widest point in the middle. The observations were interpreted as an extrapleural column of air arising in connection with artificial pneumothorax. (Fig. 3 a.)

Roentgen examination on November 15 showed considerable reduction in the size of the extrapleural pocket. (Fig. 3 b.)

Renewed roentgen examination on April 16, 1946 showed complete disappearance of the extrapleural collection of air. At its site was a narrow pleural thickening along the chest wall.

Case 4. — A woman, aged 36. Clinical record 138/44. Tuberculosis of the right lung. Artificial pneumothorax.

Pneumothorax was induced on the right side in 1944 and refills were given every second week. On March 11, 1944, thoracoscopic examination was performed and a superoposterior band severed by cauterization.

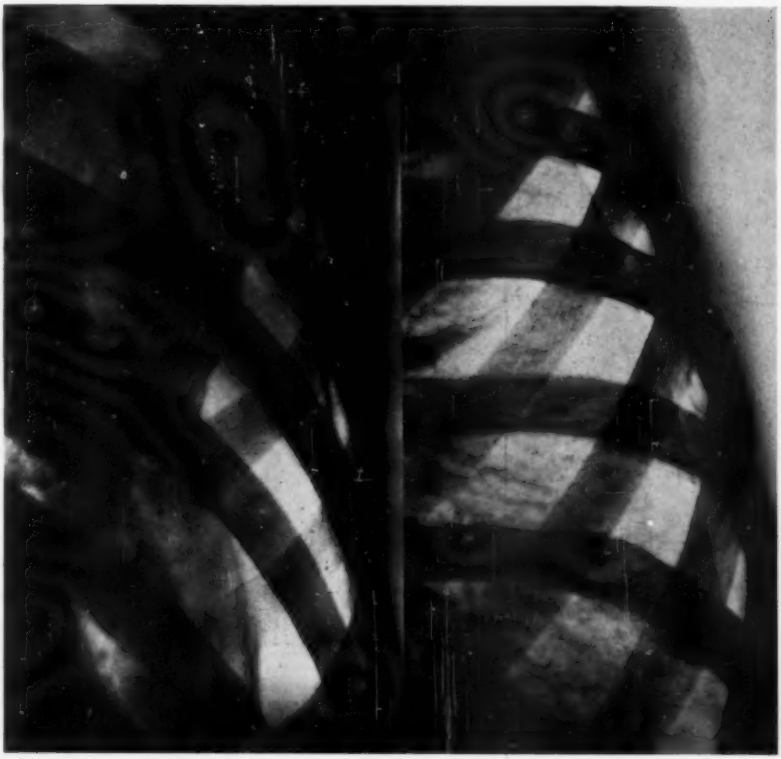


Fig. 3 a. Fig. 3 b.

Fig. 3 a. Case 3. Column-shaped, centimeter-wide extrapleural accumulation of gas lateral to the middle of the pneumothorax cavity.
Fig. 3 b. Case 3. Seven months later. Small remains of the extrapleural accumulation of gas are still seen.

Roentgen examination on Feb. 12, 1945 showed satisfactory collapse of the right lung. Directly over the middle of the lateral chest wall and slightly posteriorly were two adjacent air-filled cavities. They were each about 3 cm. in diameter and 2 cm. deep. They were separated from the pleural cavity by a thin membrane bulging out from the chest wall. The observations were interpreted as extrapleural air pockets formed in connection with artificial pneumothorax. (Fig. 4.)

Renewed examination eleven months later showed complete disappearance of the extrapleural cavities.

Fig. 4.

Fig. 5.

Fig. 4. Case 4. Two small extrapleural gas deposits of bullous type.
Fig. 5. Case 5. Puncture for air refill done high up. At the level of the site of puncture is a membrane circumscribing a broad extrapleural gas-filled space, 6 cm. long and 7 mm. wide at the widest point.

Case 5. — A woman, aged 23. Clinical record 117/45. Tuberculosis of the right lung. Artificial pneumothorax.

Pneumothorax was induced on the right side in 1943 and maintained by refills about every third week. On Feb. 11, 1945 thoracoscopic examination was performed and apical adhesions on the right side were severed by cauterization. The basal half of the lung was broadly adherent to the chest wall. The apex was broadly adherent posteriorly.

When the patient came for a refill on Aug. 31, 1946 the pneumothorax cavity was found to be reduced to a narrow space situated superiorly. Puncture was done with some difficulty high up laterally.

Roentgen examination on August 31 showed pneumothorax cavity superolaterally on the right side. Along the chest wall on a level with the site of puncture was an air column separated from the pleural cavity by a thin membrane bulging from the chest wall. The column was 6 cm. long and 7 mm. wide at the widest point. Its upper border continued in under the place where the apex of the lung was broadly adherent. The observations were interpreted as an extrapleural air column in the apex of the right thoracic cavity arising in connection with artificial pneumothorax. (Fig. 5.)

Case 6. — A man, aged 19. Clinical record 417/43. Tuberculosis of the right lung. Artificial pneumothorax.

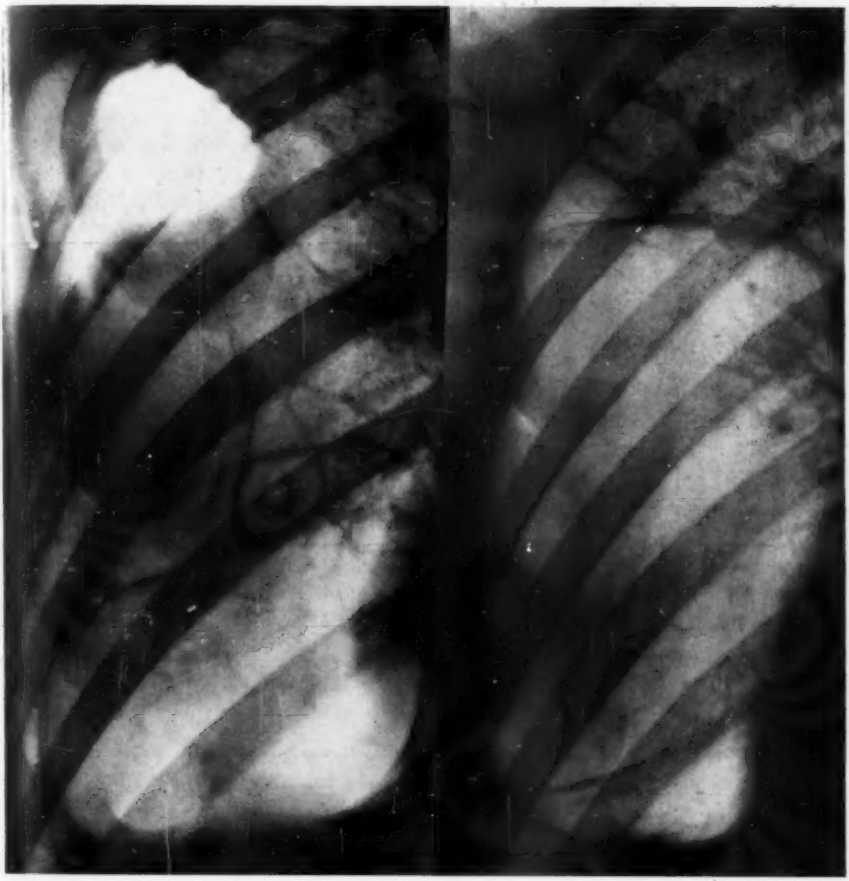
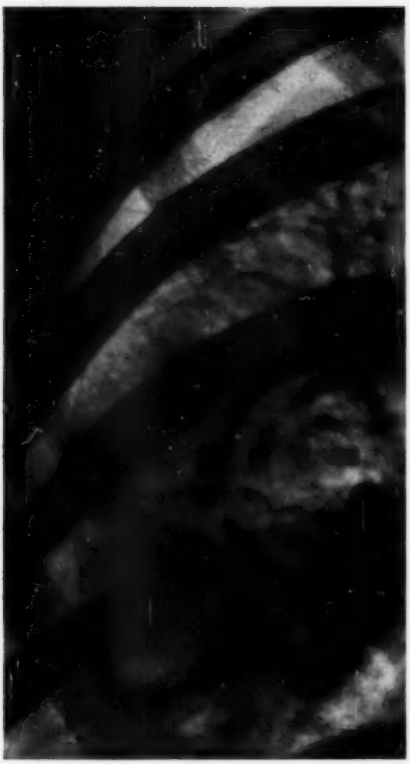


Fig. 6 a. Fig. 6 b.

Fig. 6. a. Case 6. A fairly wide extrapleural space has arisen anteriorly and basally after a powerful refill of air to try to loosen the lung which had begun to adhere. Medial to this space is a narrow intrapleural pneumothorax and medial to it, in turn, a large emphysematous bulla. The detached parietal pleura is partly in contact with the visceral pleura.

Fig. 6 b. Case 6. A little less than four months later. Both the extrapleural and intrapleural gas has been absorbed and the wall in the large emphysematous bulla has become adherent to the chest wall. The pneumothorax cavity has thus been destroyed.



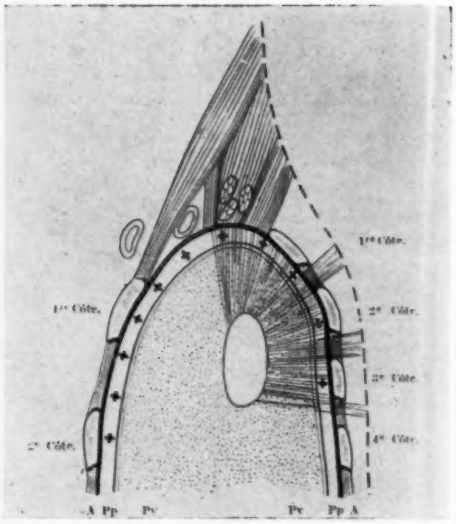


Fig. 7. Fig. 8.

Fig. 7. Case 7. Column-shaped, cm.-wide extrapleural gas-filled pocket at the middle of the lateral chest wall. Collapsed lung partly in contact with the membrane from parietal pleura.

Fig. 8. Schematic representation of the topography of the chest wall (after ISELIN). The section marked with a cross is the plane for the detachement of the parietal pleura from the endothoracic fascia.

Pneumothorax was induced on the right side in 1943. Apical adhesions were present. In the beginning of 1944 the base of the lung began to become broadly adherent. On December 23 a large refill of 650 cc. to a final pressure of + 24 was given in an effort to get the lung free.

Roentgen examination on December 23 showed an air pocket laterally and anteriorly beside the basal half of the chest wall. It was circumscribed medially by a thin membrane bulging from the chest wall. It was 2.5 cm. wide at the base and tapered off toward the top. Medial

To the membrane was another, long airfilled cavity, only a few millimeters wide, bounded medially by another similar membrane. This second membrane formed the lateral wall of a fist-sized, round, airfilled cavity, the medial wall of which consisted of partly compressed lung tissue. The two membranes were partly touching. The observations were interpreted as an extrapleural air column, the medial wall of which, formed by parietal pleura, partly bounded a narrow intrapleural pneumothorax cavity and partly the wall of a large emphysematous bulla. (Fig. 6 a.)

Later examinations showed that the extrapleural cavity disappeared. After the air refills a large rounded air-filled cavity, measuring 15 by 10 cm., remained. Its lateral border lay along the chest wall, while medially it was bounded by compressed lung tissue. This cavity had the appearance of a large emphysematous bulla. (Fig. 6 b.) Thus the air must have been situated within the lung.

(The case probably corresponds to the one of severe bullous emphysema described by JACOBÆUS in Acta Radiologica 16, 1935.

Case 7. — A man, aged 58. Clinical record 106/47. Tuberculosis of the right lung. Artificial pneumothorax.

Pneumothorax was induced on the right side January 24, 1947.

Roentgen examination five days later showed collapse of the right lung. At the middle of the lateral chest wall was a columnar collection of air, 6 cm. long and $1^1/_2$ cm. wide at the maximum, and separate from the pleural cavity by a mm.-thick membrane. At this point the distance between the collapsed lung and the membrane was only $^1/_2$ cm.

Pneumothorax artificialis dx. with an extrapleural gas-filled cavity (Fig 7). At control three weeks later the right lung was considerably collapsed but the pleura parietalis and pleura visceralis were in contact and an adhesion existed between the lung and the bulging pleura parietalis.

The anatomic conditions which lie back of the development of an extrapleural pneumothorax are the following.

The thoracic cavity is lined first by the endothoracic fascia. This fascia is firmly attached to the periosteum of the ribs and the aponeuroses of the intercostal muscles. The thoracic cavity is next lined by the parietal pleura: laterally by the costal pleura, inferiorly by the diaphragmatic pleura and medially by the mediastinal pleura. At the hilus the parietal pleura continues over into the visceral pleura. (Fig. 8.)

The costal pleura is attached to the endothoracic fascia by a layer of fairly firm connective tissue. It can be detached from the fascia over almost its entire extent along the chest wall. This can be done

surgically, as in the open operation of extrapleural detachment. However, it can also be detached by puncture and filling with air. Lefèvre Gau and Schmidt, for example, use a method called »le soufflage des adhérences». By injecting gas extrapleurally at the site of attachment of adhesions, the attachments are made to approach the collapsed lung with the palliative result that the lung is no longer kept distended by the adhesions.

Finally, this can happen involuntarily, as in the described cases. An extrapleural pneumothorax arising in connection with the injection of air for collapse therapy may be due to the use of a coarse, blunt needle or a needle with a long opening. In the former case the needle strips off the parietal pleura instead of immediately penetrating through it. In the latter case, only part of the opening may lie inside the pleural cavity, and air be pressed into the extrapleural tissue through its lateral portion. Finally, in the case of difficult puncturing conditions, air may be deposited directly in the tissue. Oechsli also suggested that the separation might be started by the injection of anesthetic solution before the introduction of gas.

If the needle stops in a small extrapleural space, the pressure rises rapidly after only a small amount of air has been injected. Davy and Rolland made careful measurements in one case. When the extrapleural cavity was punctured, the pressure rose after only 65 cc. of gas from —2, —7 to +4, —3. After the needle was inserted into the intrapleural cavity, 360 cc. of gas could be injected with a rise in pressure from —2, —16 to —1, —8. Pressure conditions of this kind were not observed in any of our cases. The extrapleural pnemothorax in these cases was due to the use of a needle with a long opening or to difficulties in making the puncture. The pressure sometimes deviated from the usual in the latter cases, but normal values were obtained when the position of the needle was shifted.

Roentgenographic Signs. — The detached parietal pleura is visualized in the roentgenogram as a membrane bulging out from the chest wall over a short or long distance. As a rule, the membrane is hardly a millimeter thick, but in the case of thickening of the parietal pleura it may be slightly wider. The extrapleural pneumothorax cavity outlined by the membrane may be an entirely free space, the width of which naturally varies greatly from case to case depending upon the amount of gas deposited extrapleurally. It may also be more or less partitioned either by bands or by broad adhesions of the pleura over small regions giving it a wavy medial outline. The extrapleural collection of gas is generally column shaped when the pleura is separated from the chest wall over a large extent. When it is situated in a region where the parietal pleura can only be detached over a small

area, it is cyst-shaped. It may be situated anywhere along the chest wall depending upon where the puncture was done.

It takes a long time for the gas in the extrapleural space to be absorbed. In case 2 the extrapleural space was still there two years after its development. In this case the parietal pleura was fibrously indurated and probably acted like a stiff wall preventing the cavity from collapsing. The stiff wall probably also helped to maintain an open communication between the extrapleural and intrapleural cavity. In case 1 gas was still observed in the originally comparatively small extrapleural space seven months after its development and in case 3 remains of the cavity were still observable six months later. *It is thus obvious that the partitioning wall created by the extrapleural deposit of gas causes pneumothorax cavity to undergo a long standing reduction in size.* The degree of the reduction varies, naturally, but may be considerable if the parietal pleura is easily detached. Thus the extrapleural cavity diminishes the free pneumothorax space to a corresponding, often high degree.

The frequency of this phenomenon is difficult to estimate, but it is certainly not uncommon. It is not always detected, however, for various reasons. The most common one is that usually the roentgen examination is done before the gas is injected, while afterwards only fluoroscopy is performed. The reason is that it is wanted to see the effect of the therapy on the diseased lung area in the roentgen examination, and this is easiest to do when the lung is distended. After the gas has been injected, the degree of collapse can generally be easily judged by fluoroscopy only.

There is not much chance, however, on fluoroscopic examination after the injection of gas to detect extrapleural cavities because of their discrete nature and lack of immediate effect on the collapsed lung. Accordingly, one generally has no opportunity to observe the extrapleural pockets roentgenographically until some time after their development. Even so they may be overlooked, for as a rule they only appear clearly in frontal pictures when they are situated entirely laterally.

Significance. — Accidental extrapleural pneumothorax is of practical importance for the following reasons.

It may give rise to clinical symptoms, consisting of pain in the hypochondrium and a »tight» feeling in the chest. The symptoms are generally mild and dependent upon the size of the cavity. None of our patients complained of any such symptoms.

The extrapleural cavities may be confused with adhesions. Cases are reported in which pneumothorax treatment has been stopped

because an irregular extrapleural pneumothorax was interpreted as broad adhesions.

Manometric changes of the type described may be puzzling and lead to the untimely abandonment of collapse therapy.

A fourth reason, perhaps the most important of all, has not been mentioned by other authors. The extrapleural deposit of gas brings the two pleural sheaths nearer to one another. Thus, even when the lung is well collapsed, if there is a large extrapleural accumulation of gas, the visceral and parietal pleura may be separated by only a relatively narrow cavity. This favors the development of adhesions between them (case 7). The gas in the intrapleural cavity being more quickly absorbed than that in the extrapleural cavity, the risk of adhesion is greatly increased toward the end of an interval between refills. This may mean the destruction of a pneumothorax cavity. Case 6 is an illustration. Another good example is seen in case 10 of D'ANGELO's series. FILLA's case is a third example. In the latter case, however, it was possible to maintain the collapse by large extrapleural refills.

SUMMARY

It may happen when gas is injected intrapleurally for collapse therapy that some is accidentally deposited extrapleurally. The author describes the anatomic conditions back of this phenomen, its roentgenographic appearance, frequency and significance. The greatest disadvantage of accidental extrapleural pneumothorax lies in the risk of adhesions it incurs, because of the closer apposition between the pleural sheaths and a corresponding reduction in the size of the pneumothorax cavity.

ZUSAMMENFASSUNG

Bei intrapleuraler Auffüllung von Gas zu Kollapszwecken kann es vorkommen, dass ein Teil davon unversehens extrapleural deponiert wird. Verf. beschreibt die dieser Erscheinung zugrunde liegenden anatomischen Verhältnisse, ihr röntgenologisches Bild, ihre Häufigkeit und Bedeutung. Der grösste Nachteil eines Zwischenfalles in Form eines extrapleuralen Pneumothorax liegt in der Verwachsungsgefahr, die er durch Annäherung der beiden Pleurablätter und entsprechender Verkleinerung der Grösse der Pneumothoraxhöhle mitsichbringt.

RÉSUMÉ

Lors de l'injection d'un gaz dans la cavité pleurale pour obtenir un collapsus pulmonaire il peut arriver accidentellement qu'il soit en partie introduit en dehors de la plèvre. L'auteur décrit les conditions anatomiques sous-jacentes à ce phénomène, son aspect radiographique, sa fréquence et sa signification. Le principal désavantage d'un pneumothorax extrapleural accidentel reside dans le risque d'adhérences qu'il entraîne à cause du rapprochement des feuillets pleuraux et de la réduction correspondante que subit le volume de la cavité du pneumothorax.

BIBLIOGRAPHY

D'ANGELO: Ann. Inst. »Carlo Forlanini» 18: 13, 1940.
CORBETTA: cited by Faravelli.
DAVY and ROLLAND: Rev. de la tuberc. 4: 57, 1938.
FARAVELLI: Radiol. med. 21: 1031, 1934.
FILLA: Radiol. med. 23: 439, 1936.
JELIN: Rev. de la tuberc. 3: 1139, 1937.
LEFÈVRE, GAU and SCHMIDT: Rev. de la tuberc. 4: 262, 1938.
OESCHLI: Am. J. Roentgenol. 40: 545, 1938.
OMODEI ZORINI: Riv. di pat. e clin. d. tuberc. 12: 629, 1938.

FROM THE ROENTGEN-DEPARTMENT OF THE BEILINSON HOSPITAL, PETAH TIKWAH
(SICK FUND OF THE GENERAL FEDERATION OF JEWISH LABOUR IN PALESTINE)

THE ROENTGEN EXAMINATION OF THE MEDIASTINAL LUNG HERNIA WITH REFERENCE TO TOMOGRAPHY[1]

by

Hans Salinger

Mediastinal hernia[2] may result from excessive pressure as well as from underpressure in one hemithorax. Accordingly there are two forms of mediastinal hernias:

1) one from pulsion, due to excessive pressure and

2) the other from traction due to diminished pressure. In addition to pressure-difference between the two hemithoraces the existence of certain anatomical conditions, *i. g.* the presence of circumscribed resilient areas in the mediastinum, must be assumed as a factor for hernia-formation. NITSCH (6) described two such resilient areas: the first one behind the manubrium sterni in the upper anterior mediastinum at the level of the costo-sternal junction of the 1.—3. rib, the second one in the lower posterior mediastinum at the level of the 5.—11. thoracic vertebrae. BÁRSONY and WALD (1) described a third »weak place» at the level of the 3.—5. thoracic vertebrae between the vertebrae and the esophagus. Up to the present only the upper anterior hernia has gained clinical importance.

The pulsion-hernia can be seen by fluoroscopy without employing radiographic methods: during expiration a sharply outlined transparent field appears within the increasing density of the normal lung close to the mediastinum at the level of the anterior ends of the 1.—3. ribs; during inspiration it diminishes in size or disappears. This area is an air-filled pouch of the contralateral pleura.

Traction-hernia of the mediastinum is well known (DAHM (2), H. C.

[1] Submitted for publication, May 1, 1947.

[2] In this article the term »hernia» is applied with full recognition of the fact, that there exists a difference of opinion as to whether one deals with a true herniation or a local displacement of the mediastinum only.

MAIER (5), E. KOROL (4)). There are, however, more cases of traction-hernia than one supposed till now: 30 cases have been seen by MAYER in the University of Michigan-Hospital; KOROL called it a rather common condition. I saw 6 cases in a rather short period.

The mediastinal hernia caused by traction is usually the consequence of a shrinking process of the lung (Tbc., Bronchiectasis) or of chronic bronchostenosis (tumor, foreign body etc.). Lobectomy or pleural shrinking following abolition of a pneumothorax may enhance hernia-formation. In all these cases the healthy expandable lung is pulled to the contracted side through the resilient area of the mediastinum.

The clinical importance of the traction-hernia rests upon the fact that in some manipulations as establishing of a pneumothorax or thoracic operations air may pass over into the pleural cavity of the healthy hemithorax. Such cases are reported (*e. g.* by SMITH and WILLIS (7)). The more or less sharply outlined transparent district in the opaque area may be mistaken for a tuberculous cavity or for an abscess in the lung or in the mediastinum. In cases of thoracoplasty the hernia may be diagnosed as an insufficiently collapsed part of the lung.

The physical signs and clinical manifestations are rather ambiguous. In some cases there is dyspnoe resulting from torsion of the bronchial tree of the healthy lung; thoracoplasty may be helpful in these cases (H. C. MAIER).

On account of the uncertainty of the clinical signs diagnosis is based entirely upon the Roentgen examination. The roentgenologic demonstration may be quite difficult. If in a case of contraction of a hemithorax a shift of the mediastinum is found, one should search for a mediastinal hernia. In the routine-roentgenogram the hernia may often be overlooked. Using shorter-wavelength-radiation a more transparent area is seen in the opaque side paramediastinally. This area is outlined cranially by a sharp horizontal line crossing the mediastinum at the level of the sterno-clavicular joint turning downwards laterally. The lateral border changes with the size of the hernia.

Even shorter-wavelength-radiation does not always demonstrate that borderline. Therefore MAIER proposed to take stereo-roentgenograms with a Potter-Bucki-diaphragm. Roentgenograms in lateral position give indirect signs only: the distance between the anterior wall of the thorax and the aorta is enlarged. In addition bronchography has been used for the demonstration of the shifting of parts of the lung.

The study of the pulmonary vessels, particularly by means of tomography proved to be an important help for the diagnosis of a mediastinal hernia caused by traction. In some cases a part of the apical blood-vessels of the lung are missing in the routine roentgenogram. As the number and size of the apical arteries is varying greatly (HERRNHEISSER

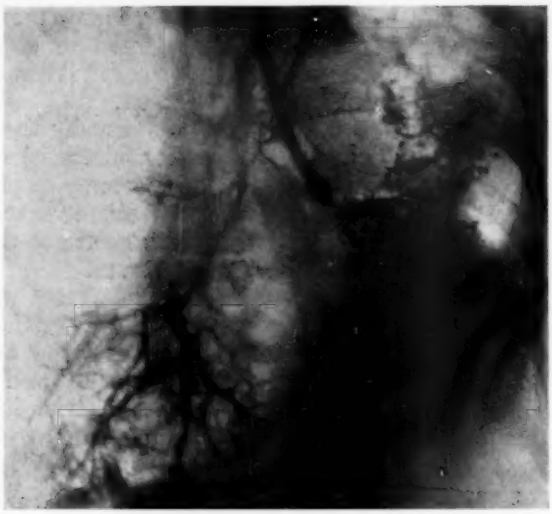


Fig. 1 (case no. 1): partial displacement of the right lower lobe; borderline of the right lung to the left of the spine. Branches of the right lower lobe bronchus passing to the left side.

and KUBAT (3)), it is safer from the diagnostic point of view to demonstrate directly the changed position of the blood vessels than to jump at conclusions from missing them at their due place. Visualization of the displaced vessels was possible by tomography in 5 of my 6 cases. In the 6th case a routine roentgenogram taken with more kV showed very distinctly an upper mediastinal hernia following lobectomy.

The tomograms demonstrate the pulmonary vessels crossing from the healthy hilum through the mediastinum into the contralateral side. The above mentioned borderline of the hernia visualized by MAIER with stereograms, was seen very clearly. The herniae were found in the layers 12 and 14 cm, counted from the back. The following tomographic technique was applied: cranio-caudal tube-shift, angle of the pendulum 30 degrees.

Case Reports

Case 1. W., male, 43 years old. History of chronic bronchiectasis. Since 1943 frequent attacks of fever up to 103 F, 1944 left pleural effusion which healed with shrinking.

Roentgen-examination June 45: there is an inhomogeneous density of the left side. Right side without pathological findings. The mediastinum is shifted to the left, especially in the lower part.

Bronchography (fig. 1): large bronchiectasis on the entire left side. The medial por-

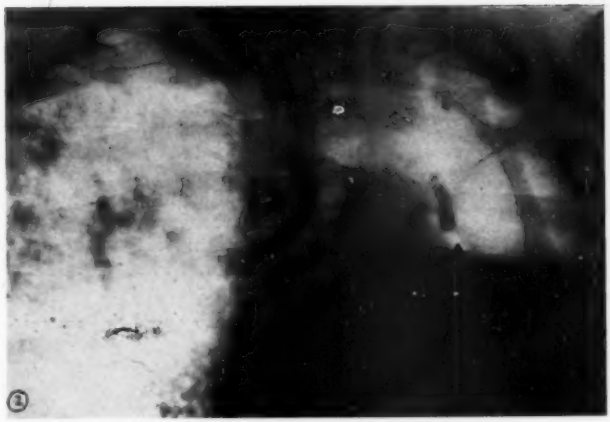


Fig. 2 (case no. 1) some days after pneumectomy: typical borderline of an upper anterior mediastinal hernia crossing into the left side.

derline of the right lung is to be seen as an arch to the left of the vertebral column. The branches of the right lower bronchus cross the spine. The apical branches of the right upper bronchus are not filled. The other branches are without path. findings. The control-bronchography (3rd May 46) showed the same findings. 19th May 46: pneumectomy of the left lung. 22nd May 46, routine-roentgenogram (fig. 2): typical borderline of an upper anterior mediastinal hernia of the lung, caused by traction, passing through the mediastinum into the left side. The trachea is shifted to the left. On the following roentgenogram (fig. 3) this line is not seen at all!

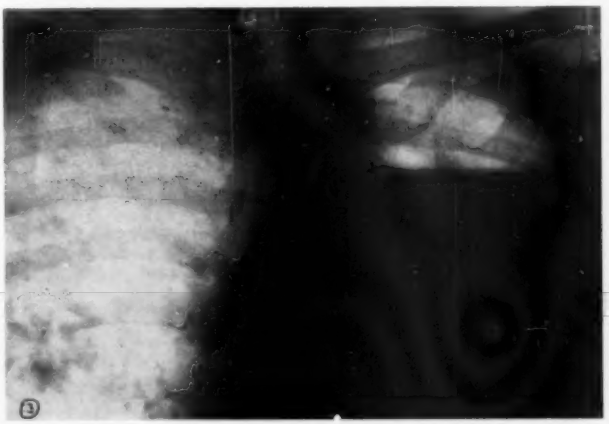


Fig. 3 (case no. 1) some days after the previous roentgenogram: no borderline is seen.

Fig. 4 a.

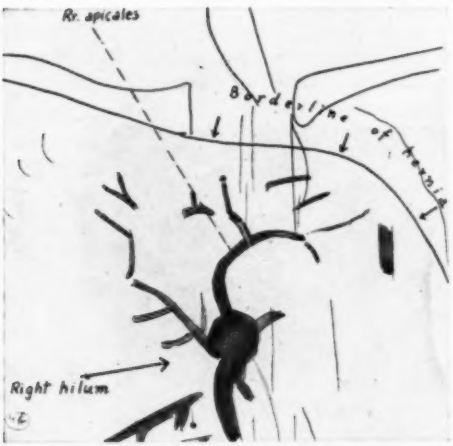


Fig. 4 b.

Fig. 4 (case no. 1) Tomography, layer 14 cm.: borderline distinctly demonstrated. Shadows of blood-vessels crossing from the right hilum into the left side.

On account of an empyema a thoracoplasty (type Sauerbruch) was performed. The patient left hospital on 28th August 46. Roentgen-examination Dec. 46: the routine-roentgenogram and the Bucki-film did not reveal a hernia. Tomography (fig. 4): a hernia is demonstrated in the layer 14 cm. There are shadows of blood-vessels crossing from the right hilum through the mediastinum into the opaque left side. This area is outlined cranially and laterally by the above mentioned borderline.

Case 2. M., female, 39 years old. 7 years ago tuberculosis of the left upper lobe. During 3 years artificial pneumothorax; 2 years ago recurrence. Sputum tbc. positive. There were findings suggestive on a cavity at the right side.

Roentgen-examination: routine-roentgenogram (fig. 5): inhomogeneous density of the left side. The trachea is shifted to the left. In between some transparent areas in the upper left field there is one outlined by an infraclavicular horizontal line, probably crossing the mediastinum.

Tomography (fig. 6): apart from the demonstration of a cavity in the left upper lobe and emphysema in the left lower lobe there are shadows of blood vessels in layer 14 cm crossing from the right hilum into the left opaque hemithorax. That area is more translucent than its surroundings and is outlined by a line, typical for an upper anterior mediastinal hernia.

Case 3. K. male, 31 years old. Tuberculous cavity of the right lung. The attempt, to establish a pneumothorax, failed. Therefore, a thoracoplasty was performed. Roentgen-examination before the operation (1th November 46): the right lung is opaque, the trachea is shifted to the right. A more transparent area close to the upper mediastinum is outlined

Fig. 5 (case no. 2): Borderline of an upper anterior mediastinal hernia, indistinctly visible in the shrunk left side.

by a horizontal line crossing the trachea at the level of the sternoclavicular joint. As there was a suspicion of a mediastinal hernia, *tomography* was performed.

Tomography: apart of demonstration of a cavity a typical mediastinal hernia of the left lung was found in layer 14 cm: the shadows of blood vessels were crossing from the left hilum into the above mentioned transparent area. The typical upper and lateral borderline was demonstrated.

Case 4. N., male, 29 years old. Cavity in the left upper lobe. A pneumothorax had to be abandoned on account of pleural effusion. The patient was admitted to our hospital for thoracoplasty. 10th October 46: Roentgen-examination before operation: irregular shadows over the whole left side. There are some transparent areas without clear borderlines suspect of cavities. Near the upper mediastinum below the clavicula a more transparent area is seen, also without clear border. The trachea is shifted to the left side.

Tomography: apart from the demonstration of a cavity there was a typical mediastinal hernia in layer 14 cm: the upper borderline and the blood vessels, crossing from the right hilum into the left side.

Case 5. J., female, 33 years old. 1935—1941 treatment of a tuberculous cavity in the left lung with pneumothorax. 1944 a new cavity was found; therefore thoracoplasty according to Maurer was performed.

1st December 46: control-roentgen-examination: apart from the typical postoperative changes of the left side the routine roentgenogram and the Bucki-film did not show any sign of a cavity nor of a mediastinal hernia.

Tomography: a small remaining cavity in layer 5 cm and a mediastinal hernia in layer 12 cm were shown. As in the previous cases there were the typical outline and the crossing of blood-vessels from the right hilum into the left side.

Fig. 6 a.

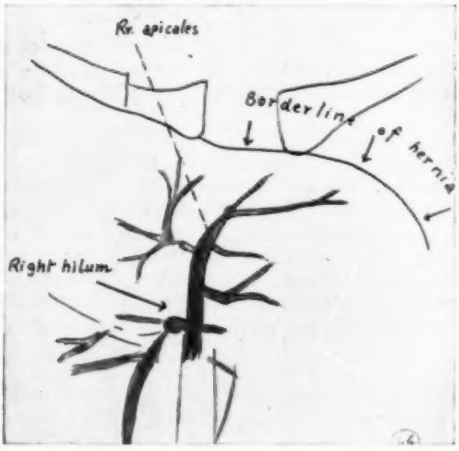


Fig. 6 b.

Fig. 6 (case no. 2): Tomography: layer 14 cm. borderline of the hernia clearly demonstrated. Blood vessels of the right upper lobe passing from the right hilum into the left side.

Case 6. M., 28 years old, male. Lobectomy of the left lower lobe for benign bronchialadenoma in the lower lobe-bronchus. Postoperative routine-roentgenogram showed apart from pleura effusion the sign of an anterior mediastinal hernia of the right lung. Tomography was not performed.

Discussion

These 6 cases show pathological changes causing diminution of pressure in the affected side in comparison with the healthy hemithorax. The cause was in cases No 1 and 6 pneumectomy resp. lobectomy, in cases 2, 4, 5 shrinking after abandonment of pneumothorax. In case No. 3 pleural adhesions prevented the establishing of a pneumothorax. In all 6 cases the difference of pressure gave rise to distortion of parts of the healthy upper lobe with herniation into the diseased side, one case from the left to the right side, 5 cases in the opposite direction. The herniation took place at the upper anterior weak place of the mediastinum. In case No 1 there was in addition overlapping at the lower posterior resilient area.

The difficulty to demonstrate the herniation reported in the literature existed also in a number of my

cases. A hernia shown already by routine-roentgen was not seen later in check-up films, but could then be demonstrated by tomography (case No. 1). In other cases (No. 4 and 5) the routine-roentgenogram did not show any typical signs, but tomography revealed the herniation. I did not use the stereoroentgenography, proposed by MAIER. This author reported that a better contrast was produced in this way and so, the upper borderline of the hernia was seen more distinctly. This is seen in many cases by two-dimensional roentgenograms too, if shorter-wavelength-radiation is used. But there are cases with thickening of the pleura and local emphysema giving confusing borderlines beyond possibility of analysis. It is in such cases that the demonstration of lung-tissue in the pouch of the hernia is superior to visualization of borderlines. The structures seen radiologically in the normal lung-tissue are the blood-vessels; they lend themselves well to be demonstrated in the herniated part of the lung by means of tomography. In these cases tomography is superior to the routine-roentgenogram for analysis of the blood vessels.

The blood vessels of the hilum are found normally in the tomographic layers 9—11 cm. In the above reported cases the hilum was seen in the layers 12 and 14 cm. This fact speaks for traction of the hilum caused by the herniation; this is consistent with the bronchoscopic findings of a torsion of the healthy side. This torsion may cause dyspnea (MAIER). It obviously makes filling of the upper branches with contrast medium difficult.

TAYLOR (8) used tomography for demonstration of pleural hernias caused by pulsion; here fluoroscopy seems to be superior because fluctuations can be observed while they are actually taking place.

SUMMARY

Mediastinal-hernias may be caused by pressure-difference in the two hemithoraces at the two weak places described by NITSCH. Hernias caused by pulsion (pneumothorax) are demonstrated by fluoroscopy. Hernias caused by traction are best shown by tomography. The diagnostic signs seen in the tomogram are the upper borderline of the hernia and the visualization of blood-vessels crossing from the healthy hemithorax into the pouch of the hernia.

ZUSAMMENFASSUNG

Mediastinale Hernien entstehen an den beiden von NITSCH beschriebenen schwachen Stellen des Mediastinum. Voraussetzung für ihre Entstehung ist eine Druckdifferenz zwischen den beiden Thoraxhälften. Pulsionshernien (Pneumothorax) werden am besten mit der Durchleuchtung nachgewiesen. Traktionshernien sind tomographisch zu untersuchen. Die diagnostischen Zeichen im Tomogramm sind die obere Begrenzung der Hernie und die Darstellung von Blutgefässen der gesunden Lunge, die in den Herniensack hinziehen.

RÉSUMÉ

Les hernies du médiastin peuvent être causées par une différence de pression entre les deux hémithorax, aux deux points de moindre résistance décrits par NITSCH. Les hernies par pulsion (pneumothorax) sont mises en évidence à l'écran fluorescent. Celles par traction se voient le mieux par la tomographie. Les signes diagnostiques visibles sur les images tomographiques sont la ligne limitant le haut de la hernie, et les vaisseaux sanguins qu'on voit passer de l'hémithorax sain dans la poche herniaire.

REFERENCES

1) BÁRSONY and WALD: Das Roentgenbild der oberen hinteren schwachen Stelle des Mediastinum. Der praevertebrale, retrooesophageale Lungenteil. Roentgenpraxis 1936, Bd. 8: 88—95.
2) DAHM, MAX: Über mediastinale Traktionsstreifen und ihre Bewegungen. Fortschr. a. d. Geb. d. Roentgenstrahlen Bd. 55: 266—275. 1931.
3) HERRNHEISER und KUBAT: Systematische Anatomie der Lungengefässe. Ztschr. f. Anatomie u. Entwicklungsgeschichte. Bd. 105, 5 u. 6. 1936.
4) KOROL, EPHRAIM: Hernia of the Lung. Amer. Review of Tuberculosis. Vol. 37: 39—48. 1938.
5) MAIER, H. C.: Mediastinal Hernia in the Absence of Pneumothorax. Amer. Journ. of Roentgenol. Vol. 39, 687—697, May 1938.
6) NITSCH, G.: Die schwachen Stellen des Mediastinums und ihre klinische Bedeutung bei pleuritischem Exsudat und Pneumothorax. Beitr. zur Klinik d. Tuberk. 1910, Vol. 18, 1—20.
7) SMITH, C. R. and H. S. WILLIS: Communication between the two pleural sacs, with lungs showing tuberculosis healed after thoracoplasty. J. A. M. A., 101, 16: 1224—1226 oct. 1933.
8) TAYLOR, H. K.: Planigraphic Examination of the Thorax in Tuberculous Individuals. Quaterly Bull. Sea View Hospital. Vol. 3: 357—374. July 1938.

FROM THE ROENTGEN DEPARTMENT OF THE COUNTY HOSPITAL, KARLSKRONA
(HEAD: I HERMODSSON, M. D.)

THE ROENTGEN PICTURE OF OSTEO-ARTHRITIS IN THE HIP-JOINT IN CASES OF POLYARTHRITIS RHEUMATICA CHRONICA[1]

by

Ivan Hermodsson

In Acta radiologica, supplement. LXVI, I have described »the roentgenologic appearance of osteo-arthrosis deformans in the hip joint». I have shown therein that »*osteo-arthrosis deformans* in the hip joint occurs in *two characteristic types: medial and proximal*, according to the localization of the destruction of cartilage. The *medial* type is found in *normally* developed joints, the *proximal* one in *maldeveloped* joints.

As a basis for judging whether a hip-joint is normally developed or maldeveloped I have made use of the CE angle (WIBERG). Concerning this angle WIBERG says that »CE angles below 20° may be considered definitely pathologic and indicating a defective development of the acetabular roof, and values over 25° definitely normal. Values between 20° and 25° are uncertain».

It appears to me that a certain lack of clarity as regards terminology prevails in the literature covering this ground, and for this reason I consider it of importance to try to construct a simple terminology which will above all take into consideration those conditions which are of practical importance.

For this reason I use the terms *maldeveloped acetabulum* and *maldeveloped joint* to describe *those cases where the CE angle is pathologic* (too small).

A comparison of the views of different writers will give a vivid impression of the great uncertainty at present prevailing both as regards the diagnosis of chronic osteo-arthritis and that of osteo-

[1] Investigations carried out with the assistance of a grant from H. M. King Gustav V: Octogenary Memorial Foundation. Read at the meeting of the Swedish Society for Medical Radiology, on March 1st, 1947; submitted for publication, May 23, 1947.

arthrosis deformans. Some consider osteo-arthrosis deformans to be a very ordinary complaint, whilst others hold the view that the majority of chronic complaints in the joints are of an arthritic nature. Many writers consider that it is hardly possible to make a strict distinction between arthrosis and arthritis.

Combinations of the two are also not infrequently found in practice. In this connection one chiefly thinks of a secondary osteo-arthrosis deformans in conjunction with an arthritis. BÜRGER (quoting from HACKENBROCH), however, speaks of 3 different ways in which it is possible for an osteo-arthrosis deformans to give rise to arthritis.

It seems to me far too unprofitable to go into the different arthrosis-arthritis theories here, even from a roentgenologic point of view. I shall in the main confine myself to my own investigations, and I wish to emphasize right from the start that these are exclusively of a roentgenologic variety. I am quite well aware that this involves a weakness, in that one must usually view the roentgen picture in conjunction with the clinical findings. At the same time it also has its advantage, as the result of the roentgen examination is not obscured by other details. However, the basic facts regarding the patients' illness are supplied by the clinical specialists. In the same way, the diagnosis for example of »polyarthritis rheumatica chronica» is made, by the clinical specialist, but the diagnostics of the hip-joint itself are purely roentgenologic.

It is, however, my hope that my investigations will be continued and added to by others. This sphere of research seems to me to be particularly well suited for what is now known as »team-work», in which roentgenologists, clinical specialists, and pathologists, amongst others, should collaborate. Only if the research work is carried out in this way is there hope of getting to the root of the complicated problems in question.

In order to obtain a firm basis for my investigations I have selected as subject-matter cases of *polyarthritis rheumatica chronica* which have been fully verified clinically, and where the diagnosis, as already mentioned, has been made by a clinical specialist. The cases are derived from the following sources: Nynäshamns Sanatorium (principal Dr. F. SUNDELIN), Tranås Sanatorium (principal: Dr. N. ÅHLÉN), Lund Rheumatic Clinic (principal: Docent G. EDSTRÖM), and also from the County Hospital in Karlskrona (principals: Dr. E. GJERTZ and Docent B. SCHERSTÉN). I am very grateful to all these principals of clinics for the readiness with which they placed research material at my disposal, and also for all the assistance I received with clinical data.

I have had access to the roentgen films which were taken of the hip-joints of patients suffering from confirmed *polyarthritis rheuma-*

ica chronica (henceforth referred to as p. r. c.), and in this way I have inspected several hundred hip-joints. In the majority of these hip-joints I have judged the roentgen finding to be normal, and have not recorded these cases in my later investigations. In the same way I have excluded two or three cases of epiphyseal slipping. There remained as the real subject-matter of my investigations a number of hip-joints where pathological changes were established by me, which changes I interpreted as a manifestation either of arthritis (or of the patient's rheumatically diseased condition), or of osteo-arthrosis deformans (or possibly a combination of arthritis and arthrosis).

In analysing the roentgenologic symptoms I have used the same classification as I described in my work on osteo-arthrosis deformans. Thus I will speak in the future of:

1. osteophytes (o),
2. cartilage destruction, cartilage degeneration (cd),
3. changes in the bone tissue, structural changes (str.),
4. double floor (df).

In this material there must be added:

5. diminished calcium content (ca).

Different types of roentgen picture appear, as I expected, as a result of variations or different combinations of these roentgen symptoms. As when dealing with osteo-arthrosis deformans I have made use of the *localization of cartilage destruction* as the *main basis of division* into different types. Thus I also speak here of *medial type* and *proximal type of cartilage destruction,* according to whether the medial or proximal part of the joint is involved. In this material must also be included a type which I term the *axial type* of cartilage destruction. In this type the greatest degree of cartilage destruction occurs in the direction of the collum axis. In these cases, however, the cartilage destruction is not infrequently high in degree, very widespread, and comprises perhaps the greater part of the joint, although less in the upper-lateral and lower-medial parts.

As in the case of osteo-arthrosis deformans, the size of the *CE angle* plays a *great part* in the rise of changes *in arthritis.* For this reason I find it necessary, in every case of arthrosis or arthritis, to try to measure as carefully as possible the CE angle, and form a definite opinion as to the nature of the joint before the occurrence of the joint changes in question.

I have distinguished the following *types of roentgen picture* in my investigations:

I. type m	III. type mr	V. type pr
II. » p	IV. » a	VI. » ca.

It may at first glance appear needlessly complicated to draw up so many different categories of roentgen pictures and in practical work such a classification can certainly be omitted. For the understanding of the pathologic happening, however, this division into types no doubt has a definite significance, which I hope to make clear later. The reason I chose letters as symbols for the different types was that this facilitates the arrangement of the cases in table form. I have myself derived considerable benefit from this when revising my subject-matter.

I shall now describe briefly the characteristics of the various types:

Type m

The roentgen picture here is identical with that which I described as the medial type of osteo-arthrosis deformans. As I mentioned earlier, in this case osteophytes are the earliest visible roentgen symptom, and therefore osteophytes (o) must always be seen before one can speak of type m. This is of importance for the understanding of what follows. I have not here found double floor in any case. CE-angle always over 20°, usually over 25°. Joints thus normally developed.

Type p

The roentgen picture is identical with that which I described as the proximal type of osteo-arthrosis deformans.

In all the cases the CE-angle is under 26°, and is usually under 20°. I term these hip-joints maldeveloped.

Type mr (See Fig. 5)

In this type of roentgen picture, the letter *m* indicates that the cartilage destruction exists exclusively in the medial part of the joint. The roentgen picture, however, differs decisively from that of type m. Even if the signs of cartilage destruction are quite pronounced it is in fact unusual to find any osteophytes here. Furthermore, an often strongly pronounced diminution of the calcium content of the entire hip-joint region is frequently found instead, usually most obvious in the head of the femur. In view of the fact that I did not find the type of roentgen picture here described during my earlier investigations of osteo-arthrosis deformans, but have found several cases in my rheumatic material, I have chosen the symbol *mr*, which will give expression to the difference, as well as the similarity, between the two types of roentgen picture. No structural changes are usually found in the femoral head. I have not in any case observed double floor. The hip-joints in question are all normally developed, with CE-angle over 20°, as a rule over 25°.

Fig. 1.

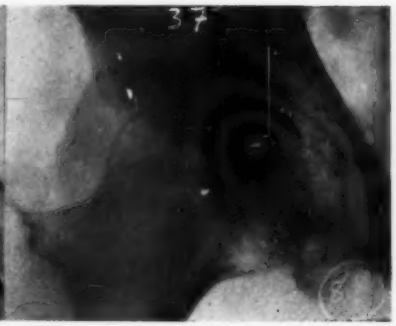


Fig. 2.

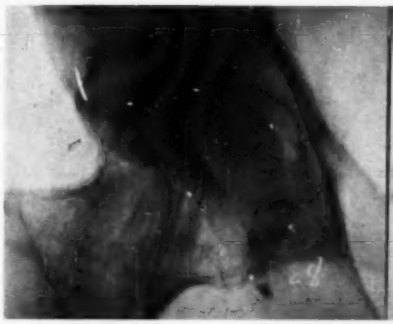


Fig. 3.

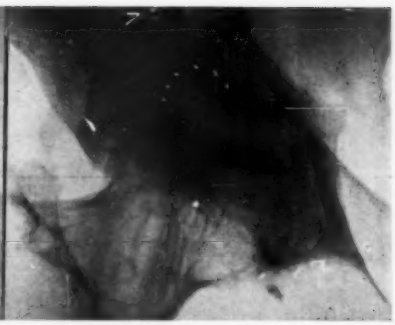


Fig. 4.

Fig. 1. ♂, 49 years. — P. r. c. (Polyarthritis rheumatica chr.) 4 years. No signs of arthritis. CE angle 30°. Floor distance («the shortest distance between the medial contour of the head and the outer side of the U-figure», HERMODSSON 1947) is 11 mm.

Fig. 2. Same joint 3 years later. Arthritis.
Formula: a (cd + str), CE 37°. Floor distance 8 mm (reduced!).

Fig. 3. ♂, 46 years. — P. r. c. 4 years.
a (cd?), CE > 50°. Floor distance < 8 mm.

Fig. 4. Same joint 1 year later.
a (cd), CE > 50°. Floor distance < 7 mm (reduced!).

Type a (See Figs. 2, 3, 4, 6, 8, 9, 11, 12)

Cartilage destruction is here of the *axial* type (see above!), hence the symbol. Osteophytes are often absent, despite severe changes otherwise, similar to the conditions of type mr. Similarly, diminution of the calcium content is found in several cases of this type. Struc-

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 5. ♂, 38 years. — P. r. c. 1 year.
mr (cd), CE 41°. Floor distance > 9 mm.

Fig. 6. Same joint 8 years later.
a (o + cd + str + ca), CE 45°? Floor dist. 4 mm (reduced!).

Fig. 7. ♂, 44 years. — P. r. c. 3 years.
m? (o + cd), CE 35°. Floor distance 9 mm.

Fig. 8. Same joint 1 year later.
a (o + cd), CE 37°. Floor distance 9 mm.

tural changes are quite common in the femoral head, and in several cases they are quite strongly pronounced. I have not found double acetabular floor in any of my cases.

I consider the *changes* which I observed in two or three cases *in the lateral part of collum femoris*, to be of special interest. In cases like these the lateral contour is in fact blurred and slightly irregular, especially proximally; the structure immediately within this, is irreg-

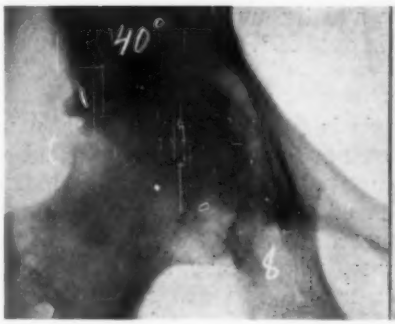


Fig. 9.

Fig. 10.

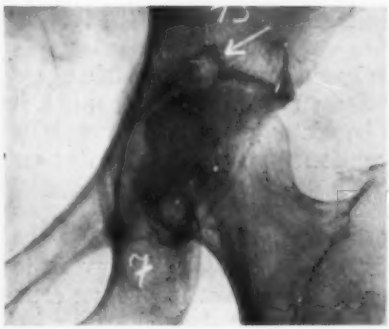


Fig. 11.

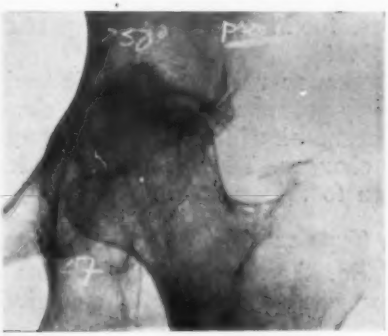


Fig. 12.

Fig. 9. Right joint on same patient.
a (o + cd + str), CE 40°. Floor distance 8 mm.

Fig. 10. ♂, 36 years. — P. r. c. for some years.
pr (o + cd + str), CE 28°? Floor distance 9 mm.

Fig. 11. ♀, 61 years. — P. r. c. 3 years.
a (o + cd), CE 43°. Floor distance 7 mm. No protrusio acetabuli.

Fig. 12. Same joint 3 years later.
a (o + cd + str), CE > 50°. Floor distance < 7 mm (reduced). A slight *protrusio acetabuli* now!

ular, and the calcium content is reduced. These changes within extend up into the lateral part of the head, and in the corresponding position on the collum-caput border are found osteophytes, which remind one of the appearance of tuberculum majus in the shoulder-joint. In my cases the destruction of cartilage in the joint is only slight. The roentgen picture now described is in reality quite characteristic. It constitutes

a form intermediate between type a and the undermentioned type, pr The CE-angle in all cases of type a is over 20°, and is usually over 25°

Type pr (See Fig. 10)

In some cases where the CE-angle is fully normal, the last-named changes in the lateral part of the collum femoris and caput, and also the osteophytes at the junction of caput and collum, are quite marked, but there is no cartilage destruction of axial type. Signs of destruction of cartilage are only slight, scarcely fully evident except in the upper-lateral part of the joint-space, where they are brought into relief by the pointed osteophytes referred to above, on the caput-collum border, and sometimes also on the lateral acetabular border.

Bone changes can also be observed in the medial part of the caput-collum border, making the contour there difficult to follow. One case gives the impression of a superficial defect at the top of the trochanter major!

The roentgen picture is quite characteristic, if the changes are fairly pronounced. It differs clearly from type p; as one cannot, however, speak of an axial type, it must be distinguished as a special type of changes. I have chosen the designation type pr. I will later on return to this matter.

Type ca

For the sake of completeness I have also included in my material those cases where I could only find a diminution of the calcium content, but where there was otherwise no sign of pathologic process in the hip-joint. This reduction of the calcium content usually extends far beyond the hip-joint itself.

(I wish to mention in conclusion, that in two slightly maldeveloped joints cyst-like formations appear in the acetabular roof, but otherwise there appears nothing pathologic.)

The classification of my subject-matter with reference to the different types of joint-changes, age, and sex, will be seen in the tabular summaries which follow (cf. tables!).

Table I.

	Types of roentgen picture						
sex	m	p	ca	mr	a	pr	total
♂	4	4	8	6	18	2	41
♀	2	14	3	6	39	4	68
total	6	18	11	12	57	6	110

Table II.

Age at date of roentgen examination	Types of roentgen picture						
	m	p	ca	mr	a	pr	total
10—19...	0	0	2	0	6	2	10
20—29...	0	2	5	0	11	2	20
30—39...	2	0	1	3	10	2	18
40—49...	1	5	0	8	16	0	30
50—59...	0	11	3	1	5	0	20
60—69...	3	0	0	0	6	0	9
70—79...	0	0	0	0	3	0	3
total	6	18	11	12	57	6	110

The material comprises 68 patients. Of these, 44 had changes in the joints of both hips, and 24 in one hip only. A further 24 hip-joints were without roentgenological changes. The total number of joints dealt with in this material is thus 136.

Discussion

The changes which I termed type m and type p in my work on osteoarthrosis deformans (a. d.) can also be found here. Are they to be interpreted here also as evidence of a simple a. d., or are they to a greater or smaller extent caused by arthritis?

Type p

The fact that no maldeveloped joints are found in any group of this material, other than in type p (where, of course, all the joints are maldeveloped), seems to me to show that the changes in type p which occur in some of these cases must be of an arthritic nature, a localization of the patient's otherwise confirmed p. r. c. to the hip-joint. Should this not be the case, the implication would be that the maldevelopment in some way shields the joints from arthritis, which is of course out of the question. One must think rather that a maldevelopment predisposes towards arthritis.

The facts relating to age point in the same direction. The fact that the age groups 60—69 and 70—79 contain no cases of type p speaks in itself very clearly. Two joints belong to age-group 20—29 and finally one finds that more than a third of the joints belong to patients below 50 years of age. For the purposes of comparison it may be mentioned that in my previously published material relating to a. d. of

type p, only 4 out of 58 joints belonged to patients under 50 years old, i. e. 7 %, and in none of the cases was the age under 40 years.

The conclusion I have reached from these facts is that *the abnormal conditions of strain in maldevelopment are of such predominant significance that in cases of maldeveloped hip-joints one cannot differentiate between arthritis and arthrosis.*

Type m

Only a small number of joints with changes of this type occur in my material *(6)*. It would therefore not be surprising if these were all of purely a. d. nature. Three of the joints belong to age-group 60—69, and a »malum coxae senile» is very likely there. In the joints belonging to age-groups 30—39 and 40—49, however, one might have reason to suspect that the patient's p. r. c. was of significance in the origin of these hip-joint changes. It is therefore of special interest that besides the six joints mentioned above with type m, there are in my material *2 slight cases of type m* in which the changes had progressed considerably when a *later* roentgen examination was made, and the roentgen picture showed a clear *type a* (age 44—45 and 66—74 years respectively). These two cases seem to me to demonstrate that *in certain cases a type m can be of arthritic nature*. It is, however, probable that this is only an exception to the general rule that type m is a sign of a. d. The explanation might very well be that the arthritis in cases of this kind is in a quiet stage with a tendency to heal up.

Type ca

A fact which has long been known is that a reduction in the calcium content of the joint extremities (»periarticular calcium atrophy») occurs not infrequently in p. r. c. In my material this reduction in calcium content has been observed partly in conjunction with other joint changes and partly as a single pathological finding in some joints. In two or three of the latter cases, a subsequent roentgen examination shows that the calcium content has again become normal, and that the roentgen finding is therefore completely normal.

I have never found any similar reduction in the calcium content in cases of a. d.

Type mr

There can be no doubt that this type is a *manifestation of arthritis*. For one thing osteophytes are as a rule missing, and for another a reduction in calcium content is found in several cases. In addition to the joints mentioned in the tables, a further 3 cases of type mr were found in my material where a subsequent roentgen examination has shown that the changes have materially progressed, the roentgen pic-

are now presenting a type a. The facts as to age also speak for themselves: with one exception all of these patients are below 50 years of age.

Type a

This is *by far the largest group* in my material, larger than all the other groups together. In this type *destruction of cartilage is always quite considerable,* in several cases nearly total. It engages both the *proximal* and *medial* parts of the joint, and is always greatest in the direction of the collum axis, upwardsmedially. The identification of this type a as a rule presents no difficulty to the trained eye. In a number of cases osteophytes are found, and one might perhaps have reason to believe such cases to be a combination of arthritis with secondary a. d. In my material, 3/4 of these joints belong to patients under 50 years of age.

Type a is without doubt the manifestation of an arthritis. In my opinion, it would seem to be a general *rule that arthritis in the hip-joint begins as a type mr and on further progression changes into type a.*

Type pr

I also consider the *arthritic nature* of the changes to be quite certain. The previously mentioned intermediate form between type a and type pr supports this. The same is the case with ages: the whole of the cases in my material belongs to age-groups below 40 years of age. The fact that the changes extend down the collum in these cases is probably bound up with the circumstance that the collum is, for the greater part, intra-articularly situated. As cartilage destruction is relatively slight in type pr, one can thus say that the changes in type pr have a predominantly *peripheral* character. The quite characteristic osteophytes in the lateral area of the caput-collum border might possibly be interpreted as evidence of a combination with a secondary a. d.

As regards the nature of the p. r. c., I would mention that the internal specialists in question have designated the illness of 56 of the patients in this material as primary-chronic, and that of 12 patients as secondary-chronic.

The high frequency of *protrusio acetabuli* in my material is worthy of note and merits special emphasis. No fewer than *5 double-sided and 3 single- side cases* are, in fact, to be found herein. The apportionment of these cases is no less noteworthy. Except for one double-sided case involving a 34-year-old woman, who also had a distinct coxa vara (collum angle 115° and 114° respectively) and in addition deformities

of the vertebral column, all pointing to a rachitis, *the following characteristics are common to* the whole of these patients:

1. Sex: *females.* 2. Age on examination: *over 43 years.* 3. Joint changes: *clear signs of osteo-arthritis, type a.* All the joints thus normally developed (i. e. none maldeveloped).

As there are in my material in all 13 female patients who were over 40 years of age at the first roentgen examination, this means therefore that 7 of these, or approximately *half,* have protrusio acetabuli. In the 3 single-sided cases the protusio is situated in the joint having the greatest changes. In one of these cases, which I examined in 1944, 1946, and 1947, a minor protusio had *originated* between the last two examinations (See Figs. 11 and 12). In another case, which was also examined 3 times (1941, 1944, and 1947), the protrusio had increased very strongly during the period the patient was under observation. I have also established the *origination* of a protrusio during the period of observation, in a woman of more than 70, who was suffering from polyarthritis, but this is outside the material now under review.) In the case of 2 of the women the changes in the hands are such that the complaint should be designated as a so-called polyarthritis mutilans. Only the above-mentioned case of protrusio was found amongst the 28 women under 40 years of age in my material. There was not a single case of protrusio amongst the 27 men.

In my opinion, my material indicates that protrusio acetabuli arose in *these* 7 cases on the basis of: *arthritis in the joint + internal secretory disturbance.* I consider that I also have grounds for believing that a special type of acetabulum, with deep and thin-walled fossa acetabuli and without a distinct U figure, constitutes a condition for the development of protrusio.

Conclusions

It appears to me to be clear from my investigations that a differential diagnosis between a. d. and chronic arthritis would probably not be possible in the case of maldeveloped hip-joints on the basis of the roentgenologic finding alone. The reason for this is no doubt to be sought in the abnormal strain conditions. Such a differential diagnosis is, however, as a rule possible in the case of normally developed hip-joints. The arthritis is right from the beginning clearly destructive in character; on the other hand, from a roentgenological point of view a. d. shows a productive nature from the start.

If the chronic arthritis in an *early* phase arrives at a calm, relatively stationary stage reactive changes may sometimes appear clearly in the roentgen picture, in the form of osteophytes, resulting

in the appearance of a roentgen picture similar to that of a primary a. d. The cartilage destruction is actually of medial type in both cases. — This does not prevent the arthritis from later becoming more active again, so that the cartilage destruction passes into the axial type, thereby revealing the true nature of arthritis.

On the other hand, should an already *advanced* arthritis come to an end or heal up, a secondary a. d. cannot conceal the primary arthritis, which can be recognised by the considerable *axial* destruction of cartilage.

The not infrequently pronounced diminution of the calcium content of the joints in arthritis is sometimes of assistance in making the diagnosis.

The above statements naturally apply only to those cases of p. r. c. where roentgenologic changes in the hip-joint *are to be found*. That cases of this kind are not, as many consider, uncommon, is clearly evidenced by the material here depicted. It is similarly manifest that in the majority of cases of p. r. c. the complaint does not engage the hip-joint. Finally, there can surely be very little doubt that the soft parts of the hip-joint can be drawn into the pathological process without the simultaneous engagement of the articular cartilage or the osseous extremities of the joints. Cases of this kind, like simple periarthritis, usually defy roentgenologic diagnosis.

It would be going too far to discuss here the extent to which the results of the investigation, as set out herein, are applicable to osteo-arthritis of genesis other than p. r. c. My own belief is that there is a great measure of similarity, at least in principle.

SUMMARY

In normally developed hip-joints one can generally distinguish roentgenologically between osteo-arthritis and osteo-arthrosis deformans. In maldeveloped hip-joints, on the other hand, such a differential diagnosis is not possible.

ZUSAMMENFASSUNG

In normal entwickelten Hüftgelenken ist eine röntgenologische Differentialdiagnose zwischen chronischer Arthritis und Osteoarthrosis deformans im allgemeinen möglich. Eine derartige Differentialdiagnose kann in dysplastischen Hüftgelenken dagegen nicht gestellt werden.

RÉSUMÉ

Dans les articulations de la hanche normalement construites, on peut en général distinguer, au point de vue radiographique, entre arthrite chronique et arthrose déformante. Dans les articulations dysplastiques, au contraire, il n'est pas possible de faire un tel diagnostic différentiel.

FROM THE ROENTGEN CLINIC OF THE STATE HOSPITAL, COPENHAGEN
(CHIEF: PROF. P. FLEMMING MØLLER, M. D.)

KYMOGRAPHIC STUDIES OF THE FUNCTION OF THE AURICLE[1]

by

Bryan Fabricius.

When one opens the thorax and pericardium on a cadaver, one sees on the left side, laterally and distally from the pulmonary artery, the left auricle projecting from the upper angle of the left atrium, whence it curves, arch-shaped, forwards and to the right, around the trunk of the pulmonary artery. With horizontal ray projection, the margin between the latter upwards and the left ventricle downwards will therefore in the frontal roentgenogram, as already pointed out by Bittorf 1905 (2) be formed, not by the left atrium, but by the auricle.

Studies of the function and movements of the auricle have so far been rather few; the general opinion seems to be, however, that its movements are not the same as those of the atrium, but are feeble and not bound by any particular law. Landois (1905) (8) thinks that the auricles serve as reservoirs to the atria, for accumulation of the abundantly inflowing venous blood; that the emptying of the atria begins from them, and that, at the same time, the veins opening into the atria become constricted by the circular fibers of the muscular layers surrounding their orifices. Langendorf (1906) (9) examined removed rabbits' hearts fed with blood, and found that the auricles did not show distinct pulsation. Hauffe (1928) (6) thinks that the auricle can only contain a small quantity of blood (3—4 cc. in adults), while in proportion to this its surface is large. He assumes that being situated at the starting point of the whole circulation it serves as a kind of motor for the movements of the atrium, imparting to the blood in the latter a direction downwards toward the ventricle when the presphygmic period ceases as result of the contraction of the inward projecting, trabecular muscular bundles; and that it thus acts like a hydraulic press on the atrio-ventricular valves.

[1] Submitted for publication, May 26, 1947.

Boehme (1936) (3) made kymographic studies on cats into the blood of which he had injected large quantities of lipiodol and thus at the same time under suitable ray projection visualised the circulation, (the so-called contrast method). He then found that above the conus arteriosus there appeared at each systole, beside the aorta shadow, between the outher contour of the heart and the shadow of the ventricle, a small wedge-shaped shadow, which disappeared again during the diastole, both movements being extremely rapid. The interior of the atrium must thus during each ventricular systole become enlarged in two ways: by an onward movement of the septum toward the apex and by the walls of the auricle distending. Boehme therefore assumes that the auricle acts as complement to the atrium by filling the free space which during each systole forms between the heart and the pericardium, and that it thus helps to keep the contour of the heart unchanged.

Wenckebach (1938) (12) says that when the inflow of blood into the atria is considerable, part of it passes on into the auricles, which thus relieve the atria, whose walls are not capable of such great expansion. Moreover, the auricles are during strong inflow of blood capable of helping the atria by expelling the blood by means of the forcible contractions of their strong musculature, the trabeculæ carneæ. On the other hand, when the inflow of blood is slight there is no such muscular action of the part of the auricle, which thus only acts as a kind of shock absorber when the pressure in the atrium becomes too great. Altogether, the auricle is extremely expansible, elastic and full of spongy muscle, and is the type of those organs which in case of copious affluxion of a fluid are capable of receiving, distributing and moderating the latter.

Benninghoff (1941) (1) finds that the auricles are substitutes for the deep niches on both sides of the vascular trunk at the base of the chambers. In mammals and in man, their size depends on the angle formed by the aorta and the pulmonary artery with the base, and by the shape of the latter. The more straightly upright the position of the heart in the thorax, the more space will there as a rule be for the auricle to develop. Also a high conus arteriosus will make the space larger. On the other hand, inward projecting aneurysms of the pulmonary artery, or of the aorta just above the valves of the latter, will greatly reduce the space otherwise available for expansion respectively of the left and the right auricle. The auricle continues to be in relation with its surroundings, the grooves between it and the latter being filled with adipose tissue. Any interstices seen there will therefore be postmortal developments. The surface of the heart, which lies airtight enclosed in the pericardium, remains smooth, without depres-

sions throughout. BENNINGHOFF does not think that the auricles have any other function.

Finally ROLLHAÜSER (1943) (10) has by examination of a large number of hearts of diverse mammals found that the auricles are fitted into the niches on both sides of the large vessels in such a manner that the heart by means of these gets a smooth surface, while the remaining grooves and fissures are filled with adipose tissue. The auricles adapt their size to the form of the niches which they have to fill. Their shape and size depend on the height of the conus arteriosus. When the latter, as it is the case in several mammals, rises above the base of the chambers, they depend on the angle which the conus forms with the base of either the right or the left chamber, and on the depth of the niches. But if these niches are filled in other ways, for instance by an aneurysm of the ascending aorta or the pulmonary artery, the auricle will be displaced laterally, and the cavity available for it will then be so small that the auricle may shrink to the size of a pea and will no longer be able to function. As the heart is enclosed airtight in the pericardium, the action of the auricle becomes like that of an organ closely adherent to its surroundings. When the niches during the systole become larger as results of the movement of the base towards the apex, the auricle will automatically fill up the space left free; and is thus an elastic filling-material for these deep niches. They are ventral extensions of the atria, serving to compensate the otherwise too strong movements in the ventral part of the base. They are thereby instrumental in assisting the heart to maintain its form unchanged during all the different phases of its action. The earlier belief that the auricles should have an actual influence on the circulation has no foundation in facts. It is indeed improbable that organs so peripherally situated should have any such influence.

Also kymographic authors studied the movements of the auricles. STUMPF (11) found identical movements corresponding to the left auricle and the right heart border: atrial systole, simultaneous movement of the ventricle, and filling and emptying respectively before and after the opening of the atrio-ventricular valves. DELHERM (4) did not find any characteristic movements corresponding to the auricle. FETZER (5) found double waves: a large, originating from the ventricle, — whose movements were so large that they propagated themselves through the atrium, — and coinciding with the ventricular waves; and a smaller, due to the atrial systole. KØTTGEN (7) found along the left auricle, corresponding with each contraction of the heart, two or three waves, which were not, however, of the same origin. Near the ventricle was seen a wave synchronous with the ventricular systole and due to propagation of the latter to the weak-muscled auricle. Near the pulmonary

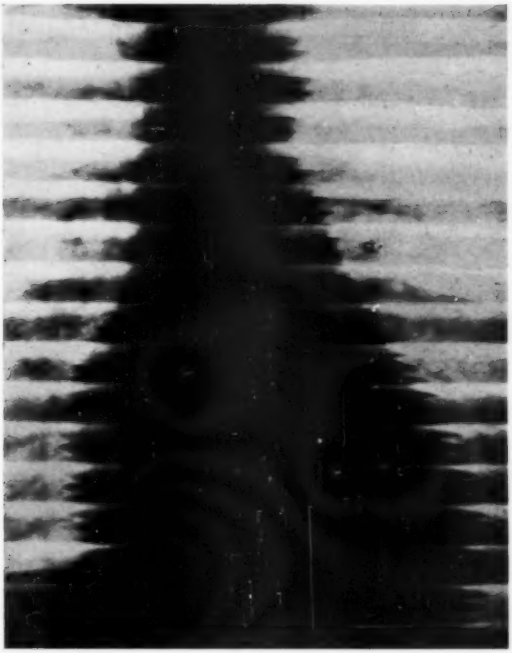


Fig. 1. Conspective kymogram, taken with 12 mm. grid diaphragm. (Plane kymogram, $^1/_2$ size).

artery the movements of the latter were seen propagated to the auricle, and just before this a small atrio-systolic wave. Often this was not seen, however, either because it was too small or because it was hidden by the lung tracing. KØTTGEN concludes that on the whole it is not possible to interpret the movements along the left auricle.

Own Studies

To estimate the movements of the left auricle I took simultaneously kymograms with falling film through grid diaphragm with slits spaced 36 mm. apart, and electrocardiograms. Under screening one of the slits was placed opposite the left auricle and the outline of the heart and the position of the slit traced on the screen and transferred to paper, so that it could be made sure later, on a conspective kymogram with dropping grid diaphragm and slits 12 mm. apart, that the movements registered were really those of the auricle.

The patient was placed on a roentgen couch sloped at an angle of 70 degrees. Thus he rests more quietly and is better able to relax. He

Fig. 2. Auricular movements corresponding to the point a in Fig. 1, taken with 36 mm. grid diaphragm. (Step-kymogram, $^1/_1$ size.)

was then connected to the cables of a transportable electrocardiograph. When the electrocardiograph and the kymograph are made to register simultaneously, the alternating current of the roentgen tube will induce into the patient a current with the same frequence of oscillation (usually 50 oscillations per second), and this will be seen in the electrocardiogram as a corresponding, finely serrated line, on which one distinctly sees at the same time, however, the recorded waves. These alternating-current serrations begin and end at the same time as the exposure from the tube, so that it is possible on the electrocardiogram exactly to delimit the section which corresponds to the breadth of the kymogram segment. As there also are time-markers both on the kymograph and the electrocardiograph, it can by simple measuring be calculated where the different kymographic vaves and parts of them fall in relation to the electrocardiogram, and thus also in relation to the different phases of the cardiac cycle.

The movements of the auricle are difficult to interpret, both because they are partly hidden behind the left hilus region and because it is a matter of very slight undulations (see Figs. 1 and 2) or small waves, any of which may occur with equal frequency, but of greatly varying size, corresponding to all phases of the cardiac cycle.

In the course of my investigation I have examined 22 young subjects, taking, in all, 38 combined kymograms and electrocardiograms and calculating the relation of the auricular waves to the movements of the border of the ventricle. For the sake of readier survey, the result is shown below in tabular form, in Table I, where x signifies incipient medial movement, o incipient lateral movement of the auricular border.

Table 1.

Atrial systole	Closing of atrioventricular valve	Opening of pulmonary valve	Apex of pulmonary valve	Closing of pulmonary valve	Opening of atrioventricular valve	Transition between rapid and slow filling of the ventricle
×	0	×	0		×	0
×	0	×			0	
×	0				×	0
×		0	×	0		
×		0		×		
	×		0		×	0

It will be seen that the picture of the contractions that take place along the border of the auricle is extremely varying. With exception of the atrial systole, during which only medial movement is found, and the transition between rapid and slow diastolic filling, where only lateral movement, is seen, both medial and lateral movements occur corresponding to all the other phases of the cardiac cycle. It is therefore improbable that the auricle should have any definite muscular function, since we find medial, lateral or no movement corresponding to the different movements of the border of the ventricle, the valves and the pulmonary artery. It must, consequently, be considered as most likely that the auricle only serves as a complementary space during the ventricular systole, to keep the surface of the heart constant.

SUMMARY

By simultaneously taking electrocardiograms and kymograms (with 36 mm. grid diaphragm) it is possible to determine the relations in time between the movements along the left border of the auricle and the left ventricle, and it is thereby found that both the medial and the lateral movements in the auricle may occur at any point of time during the movement of the border of the ventricle. It must therefore be considered as probable that the auricle does not have any independent, regular, muscular function, but only serves as a complementary space during the ventricular systole, to keep the surface of the heart constant.

ZUSAMMENFASSUNG

Durch gleichzeitige Aufnahme von Elektrokardiogrammen und Kymogrammen (mit einer 36 mm Rasterblende) ist es möglich, das zeitliche Verhältnis der Bewegungen am linken Rande des Herzohrs und der linken Herzkammer zu bestimmen, wobei man findet, dass sowohl die medialen als auch die lateralen Bewegungen des Herzohrs auf jedem Zeitpunkt der Bewegung des Kammerrandes stattfinden können. Es ist deshalb als wahrscheinlich anzusehen, dass das Herzohr keine unabhängige, regelmässige Muskelfunktion besitzt, sondern nur als Komplementraum bei der Kammersystole dient, um die Oberfläche des Herzens konstant zu halten.

RÉSUMÉ

En prenant en même temps un électrocardiogramme et un kymogramme (avec un diaphragme à grille de 36 mm.) il est possible de déterminer la relation chronologique entre les mouvements du bord gauche de l'oreillette et ceux du ventricule gauche, ce qui a montré qu'aussi bien le mouvement en dedans que celui en dehors, au niveau de l'oreillette, peuvent se produire à un stade quelconque du mouvement du bord du ventricule. On doit donc considérer comme probable que l'oreillette ne possède pas de fonction musculaire indépendante, régulière, mais sert seulement de cavité complémentaire pendant la systole ventriculaire, de façon à maintenir constante la surface du cœur.

LITERATURE

1. Benninghoff, A.: Arch. f. Kreislaufforsch. 1941, *9*, 303—310.
2. Bittorf, A.: Fortschr. a. d. Geb. d. Röntgenstrahlen 1905, *9*, 28—32.
3. Böhme, W.: Ergebn. d. Physiol. 1936, *38*, 251—338.
4. Delherm, L. E., Bordet, F. Thoyer-Rozat & Fischgold: Arch. mal. du cœur 1933, *26*, 653—684.
5. Fetzer, H.: Ergebn. inn. Med. u. Kinderheilk. 1933, *45*, 485—530.
6. Hauffe, G.: Ztschr. f. Kreislaufforsch. 1928, *20*, 633—640.
7. Köttgen, H.: Ergebn. d. inn. Med. u. Kinderheilk. 1939, *56*, 1—56.
8. Landois, L.: Physiologie des Kreislaufes. In Lehrbuch der Physiologie des Menschens. Berlin 1905. Pp. 76—118.
9. Langendorf, O.: Arch. f. d. ges. Physiol. 1906, *112*, 522—530.
10. Rollhäuser, H.: Morphol. Jahrbuch 1943, *88*, 249—267.
11. Stumpf, Pl.: Fortschr. a. d. Geb. d. Röntgenstrahlen 1934, *49*, 211—224.
12. Wenckebach, K.: Ztschr. f. Kreislaufforsch. 1938, *30*, 441—453.

FROM THE DEPARTMENT OF ROENTGENOLOGY, CAROLINE HOSPITAL, STOCKHOLM
(CHIEF: PROFESSOR ÅKE ÅKERLUND)

ROENTGENOLOGICAL HEART VOLUME DETERMINATION WITH SPECIAL REGARD TO PULSE RATE AND THE POSITION OF THE BODY[1]

by

Harry Larsson and *Sven Roland Kjellberg*

Principle of volume determination

To determine the exact volume of such an irregular body as the heart by roentgen examination, a large number of projections would be necessary. For practical reasons, only a limited number, usually two — a PA and a lateral are used. The value of the volume obtained is certainly more exact if a larger number of projections are used, but at the same time, the examination requires more time, and the mathematical calculations are more complicated. For routine work, it is therefore desirable to try to arrive at a method, which using only a few projections, gives a fully satisfactory heart determination, and deviates only slightly from the exact figure.

The volume of a body can generally be estimated from the following formula:

Area of the silhoutte × depth in the same direction as the roentgen rays × by a factor which varies from case to case.

The factor must therefore be calculated for each case. A minor variation of the factor, and at the same time a quite reliable result can be obtained if, in the equation, instead of the depth, the corresponding surface is used. In this way the surfaces in both projections will be included in the formula. When, however, the volume includes a third power, the square root of one surface must be extracted. These surface areas can be combined in volume formula in different ways. It can be arranged so that the surface area which is more accurately measured will have a greater influence on the volume estimation, than that which cannot be measured

[1] Submitted for publication, May 25, 1947.

so accurately. Because the lateral surface presents more difficulty in measurement it should be included in the formula as a square root.

The formula then becomes $V = S_1, \sqrt{S_2} \cdot k$ where S_1 is the PA surface area, S_2 the lateral surface area, and k the established factor.

Another method for calculation of heart volume is to divide both surfaces into a large number of layers of equal height — see Fig. 1. — and calculate the volume of each of these. The total volume is obtained by adding all the layer volumes according to the formula below. This method has been tried by us in about ten cases. It is probably more accurate but the calculations are very tedious and time consuming.

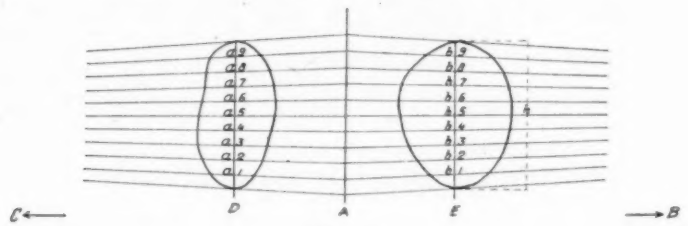


Fig. 1.

Figure 1. The object is divided into 10 slices of equal height. The distances A—B and A—C indicate the film-focus distance, A—D and A—E the distance from the centre of the object to the film, a_1, a_2, b_1, b_2 and so on the length of the diameters parallel to the beam. h = height, F = magnification factor and k = correction factor. Volume $= k \cdot F \cdot \frac{h}{15}$ $[a_2b_2 +$ $+ a_4b_4 + a_6b_6 + a_8b_8 + 2(a_1b_1 + a_3b_3 + a_5b_5 + a_7b_7 + a_9b_9)]$

Another conceivable way to determine the heart volume from both surface areas would be to use an apparatus which simultaneously planimetrated both surfaces, and gave the volume. However, the available apparatus of this type does not readily lend itself to this purpose.

Unfortunately in many cases, the lateral heart shadow is to some extent difficult to demarcate. Thus calculation methods which are based on the PA as well as the lateral surface areas, cannot always be used. Therefore it is not suitable as a normal method but should only be used in special cases.

For practical use, one is obliged, as ROHRER and KAHLSTORF (R.—K.), to use the formula we first discussed $V = S_1 \times d \times k$ where d is the largest depth in the direction of the rays.

The most exact method for the determination of heart surface S_1 involves the use of a planimeter. When the heart, at least partially, has

the appearance of an ellipsoid, it is then simpler to calculate the surface area by the following formula for the area of an ellipse $-\frac{d_1}{2}\cdot\frac{d_2}{2}\cdot\pi$ or $d_1\cdot d_2\cdot\frac{\pi}{4}$, when d_1 and d_2 are respectively the long and short diameters. The value obtained in this way deviates only slightly from that obtained by planimetry. To simplify the calculation of the volume determination $\frac{\pi}{4}$ is included in the factor.

The volume is thus $d_1\cdot d_2\cdot d_3\cdot k_1$ where d_1 and d_2 are resp. the long and short diameters and d_3 the depth. This formula is the one most used in our calculations.

The heart measurements which are used for surface and volume calculations must always be corrected for magnification before they are inserted in the formula. The correction is easily made according to the method described on page 165—167.

For other volume determination methods, the reader is referred to ZDANSKY, ROESLER and JONSELL.

ROHRER and KAHLSTORF have indicated the factor k to be a constant — 0.63 by orthodiagraphy; while JONSELL states that it is 0.42 by radiographing with a film-focus distance of 1.5 meters. JONSELL's factor includes $\frac{\pi}{4}$. Some correction is made by JONSELL for magnification.

As mentioned earlier and as shall be shown later, the factor k is not constant but varies with changes in the shape and tilt of the heart. Thus the factor must be determined for each case. For the determination of the factor, a large number of heart models of different shapes and positions must be imagined, and the factor empirically determined for each. By deciding which of the heart models the case being examined resembles most, the correct factor can be obtained for each case.

This procedure is difficult to apply in practice, partly because the number of models must be very large, and partly on account of the difficulty of deciding which model should be used.

We have therefore tried, for practical use, to arrive at a simpler way of finding the factor. Because the factor changes with the shape as well as inclination of the heart, we attempted to determine a function which varied with both of these and from which k could be derived.

It is however, impossible to find such a function, which would be valid for all bodies from two projections only.

The relation between the square of the depth and the surface area of the heart (PA projection) gives, however, an approximate idea whether the heart is spherical or flattened. As shall be shown later, a heart which

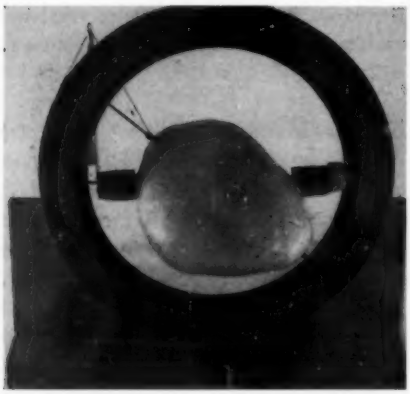
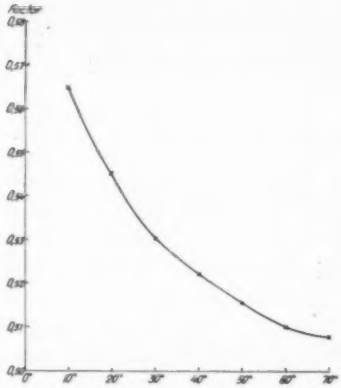


Fig. 2 a.

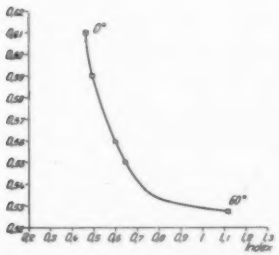
Fig. 2 b.

is nearly spherical has a low factor, while one which is flatter has a high one. We have called this quotient, the relation between square of the depth and the frontal area, the index or I.

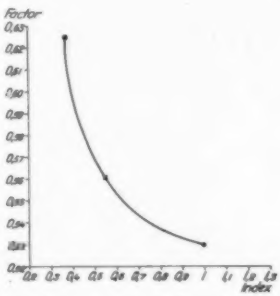
In order to study the relation of the factor to the shape and inclination of heart shaped bodies, we made a number of heart models of different forms. We have used a cast of one of TAIPALES heart models as a basis. The other models were made either rounder or flatter than the basic model. To control the results which were obtained with the models, the investigation was repeated with autopsy hearts of different shapes and sizes. These hearts had been filled with paraffin immediately after death to prevent changes in shape. After determining the volume by submerging them in water, the different heart models were balanced on a ship-compass-like apparatus with an axis going through the heart's centre — see fig. 2 a & b. Orthodiagraphic tracings of the heart were then carried out with the heart tilted backwards as well as sideways. The factor k as well as index I were determined for the different heart models in different tilts. Through this, it was found that no alteration in the factor was obtained by lateral tilting of the heart whereas tilting backwards distinctly influenced it. The connection between the factor and the degree of tilting in such a model is evident in curve 1, and that between the index and the tilting for the same heart in curve 2. In this curve a tilting of



Curve 1.



Curve 2.



Curve 3. ■ flat heart. × normal heart. ⊙ spherical heart.

0° corresponds to an index of 0.46 and a tilt of 60° posteriorly to an index of 1.12. It is apparent from these curves that the factor is also changed with the degree of heart tilt.

To ascertain the connection between the factor and the form of the body, the different heart models were placed in the »compass» described above, with the anterior surface vertical. By this, the connection between factor and form is obtained without the influence of the tilt. It is evident from curve 3 that the factor varies markedly with the heart models shape. An almost spherical heart model gives a factor of 0.53, while an extremely flat heart model gives one of 0.625 and an intermediate type of heart a factor of 0.56. $\frac{\pi}{4}$ is included in these factors. The corresponding values of the index are 1.0, 0.36, and 0.55. The theoretically calculated factor for a sphere is 0.523 against an index of 1.27 which is evident

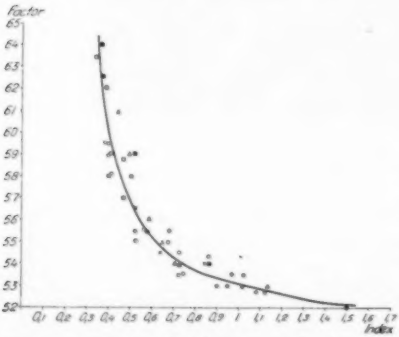
from the following: The volume of a sphere with radius r is $\frac{4\pi}{3} \cdot r^3$. The same volume calculated according to the heart formula: $d_1 \times d_2 \times d_3 \times k$ is $2r \times 2r \times 2r \times k$

$$\therefore \frac{4\pi}{3} = 8r^3k$$

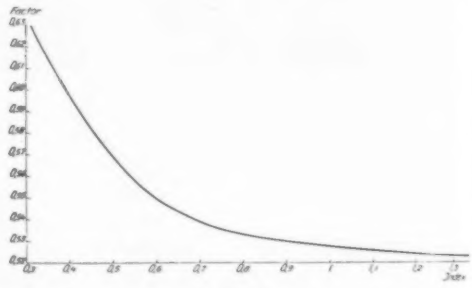
$$k = \frac{4\pi}{3 \cdot 8} = \frac{\pi}{6} = 0.523$$

Index for a sphere is $\frac{4r^2}{\pi r_2} = \frac{4}{\pi} = 1.27$.

For a sphere-like heart model, a factor 0.528 and an index 1.12 are obtained which show a good agreement between that found empirically, and the value calculated for a sphere.



Curve 4. ■ very flat heart. □ flat heart.
× △ intermediate type of heart.
⊙ spherical heart.
○ corpse hearts.



Curve 5.

If the curves concerning the relation between index and factor, which are obtained for the different heart models with respect to shape and tilting, are combined in one graph, the following curve 4 is obtained.

From this it is evident that the values show so little spread, that they allow the drawing of a common intermediate curve which may be seen in curve 5. This curve, in which no magnification factor is included, shows the relation between the index and factor k. From the same curve the factor k of the examined heart can be directly obtained after calculation of this index. This is, however, only useful for heart shaped bodies.

The heart is not a rotating ellipsoid and the factor included in R. — [illegible]

formula which for a rotating ellipsoid is $\frac{\pi}{6} = 0.523$, must be exchanged for that empirically found for the heart.

Method of volume determination

The patient is placed prone on a cassette holder having two sides at right angles to each other. See fig. 3 & 7. This position has been used by us in all cases, partly because the heart remains more parallel to the horizontal plane, and partly because the magnification is less. The object-film distance is less variable than in supine position.

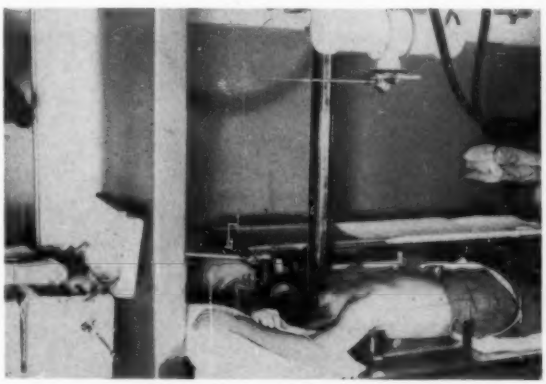


Fig. 3.

A drawback of this set-up is that no provision is made for severely decompensated patients. In these cases, however, the exact heart measurement does not play an essential part. If, in these cases, the clinician is interested in seeing, whether the heart has increased or diminished in size as the result of treatment, this information can be obtained with the patient in other positions.

With the patient in prone position, PA and lateral radiographs are taken with the shortest possible exposure time. This should not exceed 0.3 sec. The exposure is released through an ECG apparatus with an attachment coupled to a built-in relay which gives an exposure at any desired point in the heart cycle. Thus it is not necessary to take simultaneous PA and lateral pictures with different tubes, but can do them separately with the same tube. Because the heart is largest at the end of diastole, the exposure is performed in maximum diastole just before the

R wave, fig. 4. Since the heart movement at this time is slow and insignificant, the sharpness of the heart image is maximal.

The largest filling of the ventricles occurs in the beginning of diastole but the decrease at the end of diastole is usually of little significance

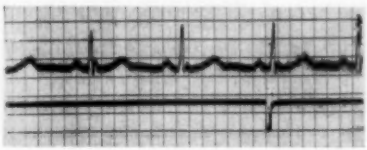


Fig. 4.

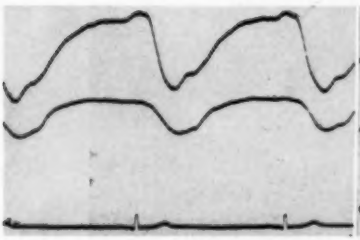


Fig. 5.

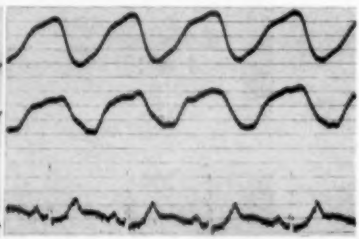


Fig. 6.

Fig. 5. The uppermost curve registers the movements of the left ventricle at the apex. The abruptly descending part corresponds to systole, the rising to diastole. Marked bradycardia.

Fig. 6. Both upper and lower curves show that the heart at the point of transition from systole to diastole — at the end of the T wave — remains moderately still for a short time.

especially in bradycardia when the diastolic phase is long. This is apparent from the electrokymogram in fig. 5. On the other hand, if one wishes to radiograph the heart in systole, it should take place at the end of systole — corresponding to the end of the T wave. See fig. 4. The heart then remains moderately still for a moment before the filling of the ventricles again begins, fig. 6. This time of exposure lends itself especially to the study of mitral lesions. The auricles are then filled to the greatest degree, and cause the maximal impression on the barium filled oesophagus.

The difference between the volume of the heart in systole and diastole may not be considered as equivalent to the stroke volume, because even the variations in the auricles are included in the values obtained. Because in diastole the ventricle is large and the auricle small, and in systole the reverse, the difference in heart size between systole and diastole is

ess than the stroke volume. The statement made by HUBACHER that the lifference in heart volume between ystole and disatole should be the same s the stroke volume is thus erroneous.

An ECG is taken at the same time s the exposure, whereby the pulse rate s obtained. On the ECG is marked the noment of exposure and its length. In his way the occurrence of the exposure t the right moment is controlled. See ig. 4.

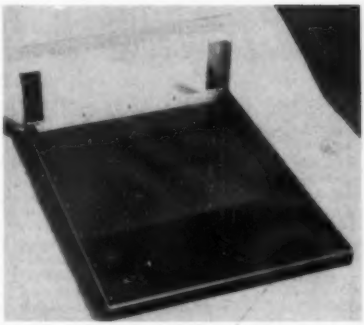


Fig. 7.

To avoid the change in heart volume which occurs with changes in intrathoracic pressure, for example — Valsalvas effect, the patients should take small shallow breaths during the exposure.

Fig. 8 a.

Fig. 8 b.

To note the magnification found in the horizontal as well as the vertical parts of the cassette holder, small lead short 1 cm apart can be inserted. These markers are reproduced in the films and the distance from the film is known — see fig. 7 and 8 a—b. To determine the magnification it is only necessary to find the marker which corresponds to the centre of the heart. To simplify the correction, we have made a ruler with which the corrected measurement can be read directly. See fig. 9. There is generally no difficulty in determining the centre of the heart.

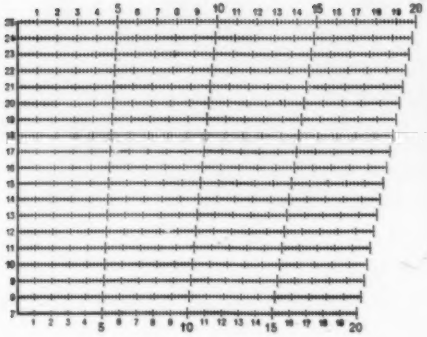


Fig. 9.

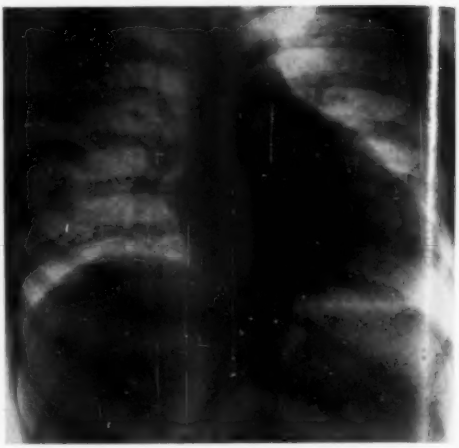


Fig. 10.

In the lateral views the greatest depth is divided into two. In the PA projection the centre can be determined by judging with the eye. In this situation the eye is a delicate instrument, and the error in the position of the centre point is seldom more than a few mm. This is evident from our control measurements. If it is necessary, sometimes to control the exact centrepoint, the PA image of the heart is drawn on a piece of paper. Then it is cut out and hung up with a pin in two different points. Where the perpendiculars cut each other is the centre point.

The heart shadow can often be more easily outlined in lying than in upright position, and in a large number of cases the lower border is entirely or partly visible in properly exposed films — see fig. 10. Generally, the posterior border is well seen without contrast medium in the oesophagus, but for safety's sake a small spoonful of barium should as a rule be given.

The effect of the body's position and pulse rate on the heart volume

The experimental study of the influence of the body's position on the circulation was begun as far back as at the end of the nineteenth century. SALATHÉ and HILL showed that if an experimental animal was placed in vertical position with its head up, there gradually ensued a deficiency in circulation and respiration. This occurred more rapidly if the vasomotor tone of the splanchnic plexus was reduced by cutting the spinal cord, or if the intraabdominal pressure was decreased by opening the abdominal wall. Later it was also shown that in ether anaesthetised dogs

he blood flow in the carotid artery diminished or increased by about 30 % by changing from the horizontal to vertical attitude with the head up or down respectively.

In the case of humans, the adaptation of the circulation in different positions of the body is much better than in four-legged animals. Thus the results of the above experiments cannot be directly applied to humans. In humans it is considerably more difficult to study experimentally the effect of position changes on, for example, the heart size. However, MORITZ as far back as 1904 was able to show, with the aid of roentgen-rays, that the heart became smaller in upright than in lying position. DIETLEN confirmed (in 1909) this finding and like MORITZ called attention to the fact that the diminution in volume was related to the pulse rate. LINDHARD (1913) by his research showed also that the minute volume decreased in upright position.

The reason for the lessened minute volume is that in the upright position there is displacement of blood into the abdomen and lower extremities. This blood displacement brings about a decreased blood flow in the great veins, leading to incomplete filling of the heart. In its turn, this leads to a diminished stroke volume which causes a decreased pressure in the aorta.

This diminution in blood pressure, through the vasomotor receptors in the carotid sinus and arch of the aorta, brings about, amongst other things, an increase in pulse rate. The degree of this increase depends on the amount of blood displacement.

Since both the heart volume and pulse rate are dependent on the blood supplied to the heart, the heart volume will decrease in relation to the pulse rate in the standing position.

Thus in these cases, it is not the increased pulse rate which diminishes the heart volume. This, as the decrease in heart volume, only occurs as a result of the diminution in blood supplied to the heart.

ASMUSSEN, CHRISTENSEN and NIELSEN point out that, under the premise that the circulation organ always adjusts itself to work as economically as possible, it is hard to understand why the horizontal position should give rise to a larger minute volume than passively standing, since the consumption of energy is the same in both cases. This therefore brings up the question: is the minute volume in the standing position smaller or is that in the lying position larger than that required to keep up the normal function of the different organs of the body? They came to the conclusion that the circulation in the standing position is inadequate. They found that in the upright position the function is distinctly depressed in at least some of the organs, such as the intestines and kidneys They hold that this is due to a compensatory contraction of the vascular plexus, which protects these organs, and counteracts the hydrostatic

blood displacements. These slight circulation insufficiencies in certain vascular plexuses, in the standing position, are physiological and need not give any subjective symptoms or changes in blood pressure.

When these blood displacements cause circulatory insufficiency with subjective and objective symptoms and signs, the clinical picture of orthostasis is present. This symptom complex has been studied by BJURE and LAURELL (amongst others) under the name of orthostatic arterial anaemia. These authors have pointed out that in a case of this type, larger blood displacements than normal occur, and the heart's stroke volume may diminish down to 50 %. At the same time, the systolic pressure decreases and the pulse rate rises. If on the other hand, the patient is immersed in water up to the nipple line, whereby the hydrostatic blood displacement is hindred, these symptoms fail to appear. The hydrostatic blood displacements bring about a diminution in heart size, chiefly from decreased blood flow to the heart through drop in blood pressure in the great veins, but possibly even by increased pulse rate which shortens the diastole.

MEEK has studied the influence of venous pressure on pulse rate in dogs. Experiments were carried out with the animals on their back thus excluding hydrostatic blood displacements. The pulse rate was then altered by atropine or through electrical stimulation of the vagus. When the venous pressure was held constant by the continuous administration of saline-acacia solution in the vena jugularis, no change in heart size was obtained even if the pulse rate increased from 60—200/min. On the other hand, if the above solution was not supplied, the venous pressure in the anaestethised dogs sank when the pulse was increased. At the same time the heart size decreased. If the flow to the heart was kept normal by keeping the venous pressure sufficiently high, then a change in pulse rate gave no alteration in heart size. This is found, however, only if the pulse has not increased so much that the heart cannot be filled during diastole.

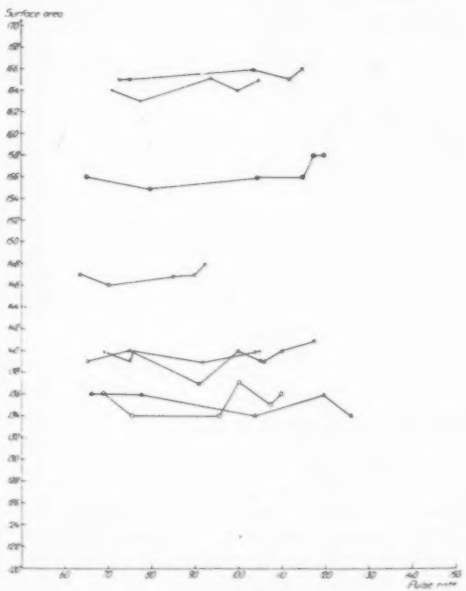
HODGES and EYSTER studied the connection between pulse rate and heart size in humans in sitting position. They altered the pulse rate by atropine injections, and found in 6 out of 9 people investigated, a decrease in heart size with rising pulse. The largest decrease — 16 %, was obtained with an increase in pulse rate from 64 to 120/min. In this investigation the decrease in blood volume occurred chiefly because of hydrostatic blood displacement.

HODGES and EYSTER drew the conclusion that heart volume determinations in upright position should not be done if for some reason or other, the pulse was increased. This conclusion, however, should in our opinion be extended to include — that volume determinations should not be done in standing position even with a normal pulse but rather in lying

position in which hydrostatic blood displacement is eliminated. This has been pointed out earlier by MORITZ, DIETLEN and many others.

Where there is suspicion of orthostasis, the volume determination should be done in horizontal as well as upright position for the purpose of comparison (ZDANSKY and others).

In the lying position, in which no hydrostatic blood displacement takes place the pulse may be increased by such causes as fever, nervousness, drugs etc. This change in pulse may alter the heart volume. To study this relationship, we have done a series of heart surface determinations in a group of individuals having an elevated pulse in lying position. On another occasion we have done a corresponding series on these individuals in sitting position. The heart surface was used for comparison because the technical resources at our disposal did not permit radiography in two directions, at right angles to each other, with tube and patient unchanged.



Curve 6.

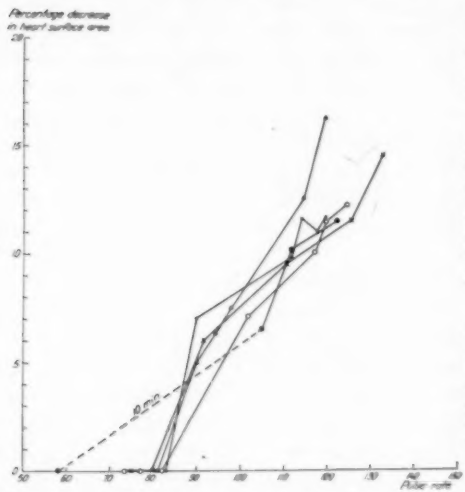
The heart surface was measured with a planimeter. Young medical students with healthy hearts were used as subjects. Scopyl 0.7—1.9 cc subcutaneously was used to increase the pulse rate. Scopyl is an atropine derivative and depresses the vagus. The heart surface was determined before and 10, 20, 30, 40, 50 and sometimes 60 minutes after injection of scopyl. No further action of scopyl is obtained after 50 minutes.

None of the 8 cases investigated in the prone position showed any definite change in heart surface area with the rise in pulse —see curve 6. It can be seen from the curve that there is no definite change in heart surface, in spite of increase in pulse in some cases to about 120/min.

NYMAN studied the action of substances belonging to the atropine group on, amongst other things, pulse rate, blood pressure, minute volume and stroke volume. He found that a rise in pulse increased the minute volume and in some cases the increase went up to almost 80 %

when the pulse rate rose to about 100. The corresponding change in stroke volume was only at most 15 cc. However, NYMAN's investigation was carried out with patients lying in a resting chair. Thus they were not completely horizontal, but at an angle of about 20°. Probably the decrease in stroke volume with the rise in pulse should have been still less or not at all, if the patients had been completely horizontal.

Should however a slight decrease in stroke volume have taken place in spite of the horizontal position, it would have been too small to be noted with this method.



Curve 7. Between the two first values on the curve ⊙ a connecting line is drawn because no intermediate values were found. Probably even in this curve the rise first begins at about 80 beats/min.

Our opinion confirms the observations made by NYMAN that the heart volume does not, or to a hardly measurable degree, reduce in size in lying position in spite of an increase in pulse rate, at least up to 120/min.

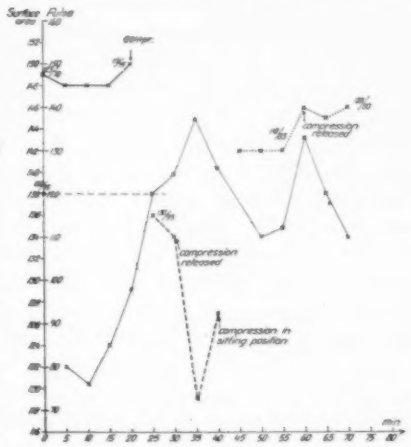
In five of those previously examined cases a corresponding series in sitting position was made. A significant decrease in heart shadow was obtained when the pulse rose — see curve 7.

As can be seen from the curve the heart shadow began to decrease in size when the pulse rose to about 80/min. The decrease occurred quickly, and similar curves run more or less parallel. The largest decrease was as high as about 16 % and occurred with a pulse rate of about 120/min. This value is exactly the same as obtained by HODGES and EYSTER in their investigation.

From what has been said before it appears that the heart size remains unchanged in lying position in spite of an increase in pulse rate up to 120/min. In the sitting position, however, a successive decrease in heart size took place with the progressive rise in pulse rate by virtue of hydrostatic blood displacement. This is made clear in the following investigation.

To obtain a final value, the experimental subject L. was roentgen-examined in lying as well as sitting position before the beginning of the investigation. In the lying position a heart surface of 150 cm² with the pulse rate of 83/min., and in the sitting position 138 cm² with a pulse rate

f 94/min. were obtained. Then, L. was placed prone on the radiographic able and 0.8 cc of scopyl was injected. During the first ten minutes after njection the pulse rate slowed somewhat but then quickly rose. Twenty in. after the injection, the pulse rate was 96/min. At that time, the irculation in both legs was cut off by blood pressure cuffs which were apidly pumped up to 300 mm Hg. L. was carefully changed to sitting osition and a picture of the heart taken immediately. The pulse had hen risen to 120/min. L. remained itting, completely relaxed, in the ame position and a new picture was aken after 5 min. The pulse had increased and the heart shadow had slightly decreased by that time. The compression was then suddenly released and a new radiograph taken. As can be seen from curve 8, on doing this the pulse rate rapidly rose while the heart shadow became considerably reduced in size. By virtue of the severe blood displacement, the patient reacted strongly and almost fainted. He recovered quickly however as the circulation became stabilized. In the first five minutes the pulse rate sank and the heart shadow increased. With the patient still sitting in the same position with his legs hanging down the circulation was again cut off in his legs with blood pressure cuffs. Then he was placed in prone position on the radiographic table. A new picture was taken which showed that the heart shadow increased while the pulse rate dropped. L. remained lying in this position for 10 minutes. Pulse rate dropped somewhat but the heart shadow remained unchanged. Thereupon the compression was quickly released. The circulating quantity of blood was thus increased and resulted in an increased heart size. The pulse rate also increased, but during the following ten minutes quickly dropped again. The heart shadow, on the other hand, remained constant.



Curve 8. The variation in heart surface area in lying position with rising pulse rate. ×– – – – – × The variation in heart surface area in sitting position ×····· × The heart surface area variation in lying position with and without artery compression of the lower extremities. ↓↑ indicates artery compression and release respectively. 115/75 blood pressure ×——× pulse rate.

From this investigation it follows that when hydrostatic blood displacement is to a large extent prevented by arrest of circulation in the legs, there occurs only an insignificant decrease in the heart on changing

the patient from a prone to a sitting position in spite of a pulse rate of 120—130/min. At the same time it follows that if the amount of circulating blood is decreased by cutting off the circulation in the legs, the heart size diminishes in lying position. When this excluded amount of blood again takes part in the circulation, the heart size increases to its ordinary value.

To get an understanding of the difference in the heart's volume during different positions of the body, we have compared the volume in lying, sitting and standing positions in a number of healthy subjects — chiefly young medical students. The percentage of volume decrease on changing from lying to sitting to standing positions has been calculated.

In 11 out of 36 subjects no change in pulse rate was obtained on changing from lying to sitting position. In these 11, the heart volume was also unchanged during the procedure. Four of the 11 were investigated in standing position and two of them showed no pulse increase in spite of standing quite relaxed for about 5 minutes. In the case of these two, there was no change in the heart volume. In both of the others the pulse rate went up and the volume decreased on standing. 25 out of 35 subjects showed increase of pulse rate on going from lying to sitting position and a decrease in heart volume at the same time. The decrease in heart volume was proportional to the pulse rate in upright position. On the other hand, no connection can be observed between the diminution in volume and the difference in pulse rate in lying and upright position. If a subject when lying down had a pulse of 90 and when standing 95 he has a volume decrease corresponding to a pulse 95 on shifting from lying to standing position. If he had a pulse of 60 when lying down and in standing one of 95, he still has a volume decrease corresponding to 95 even though the difference in pulse is here 35 against only 5 in the previous case. This is due to the fact that the pulse rate does not act on the heart volume when horizontal.

In other words, the heart volume decrease on changing from horizontal to vertical position is not proportional to the difference in pulse rate but corresponds to the level of the standing pulse — see table 1.

In 2 out of these 25 subjects, the pulse rate did not rise on shifting from lying to standing to more than 80/min. Nor did they show any

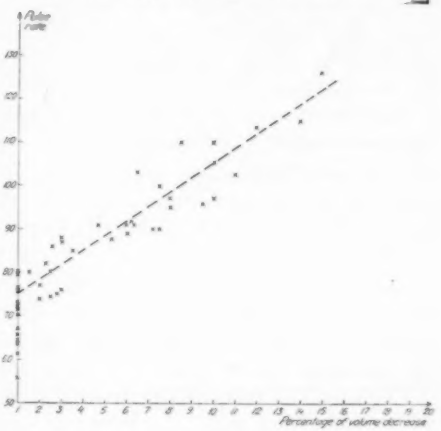
Table 1.

Patient	Lying		Sitting		Pulse increase	Volume decrease
	Pulse	Volume	Pulse	Volume		
R. S.....	100	790	103	740	3	50
B. N.....	71	650	97	605	26	45

diminution in heart volume. This, as in the scopyl experiments, indicates that the standing pulse must go above 75—80/min. before any measurable change in volume can be noted. The largest volume decrease obtained in this investigation was 15 %, and occurred with a pulse rate of 126/min., see curve 9.

This volume decrease agrees quite well with that obtained in sitting subjects who have been given scopyl.

As can be seen in curve 9 the values for the percentage of volume diminution are arranged about a middle line signifying that the relation between pulse rate and volume determination is quite stable.



Curve 9.

It should be possible to use this table for correction of the misleading value of the heart volume which is obtained in standing position with increased pulse rate. The pulse rate must be measured at the precise moment of exposure in these cases. However, a more exact determination of heart volume is obtained with patient prone.

As mentioned above, a volume diminution of about 15 % is obtained with a pulse of 120/min. In a heart of say 600 cc, this corresponds to a decrease in volume of 90 cc. NYLIN found volume decreases of up to 40 %, with 32 % as an average figure. We have been unable to verify this.

JONSELL found that the difference between systolic and diastolic filling can go to more than 20 % of the diastolic volume. If we note the difference between the index obtained for systole and diastole for the different cases in his table, it can be seen that this difference is larger for the cases who show the larger percentage difference in volume. This means that the heart in these cases changes shape and thus cannot have the same factor in systole and diastole. On the other hand, in the cases where the author has only obtained a volume change of about 10 %, the index is unchanged and thus the factor is also unaltered. If in the first named cases the same factor is used for calculation of the systolic as well as the diastolic volume, a difference is obtained which must certainly be erroneous. In the last cases, the percentage figure is probably correct and agrees quite well with the results obtained by us.

Conclusions

Different methods for the determination of heart volume have been described. For practical use, the ROHRER-KAHLSTORF's formula for volume determination has proven to be the most adaptable. However, the authors have shown that the factor included in the formula is not constant but varies with the heart's shape and tilt. The factor must therefore be determined in each case. In this article, a way determining the factor is given.

In this investigation it has been established that in the lying position, the heart's volume undergoes no demonstrable change with pulse increases up to 120/min. On the other hand, in the upright position a diminution in heart volume proportional to the elevated pulse rate takes place. The pulse rate must rise above 75—80 min. before any volume decrease can be observed. The difference in volume between lying and standing positions is not proportional to the difference between the pulse rate in the respective positions, but to the standing pulse rate.

On account of the volume diminution which the hydrostatic blood displacement causes in the standing position, the authors consider it necessary that all heart volume determinations be carried out with the patient horizontal. A simple method for heart volume determination in the prone position is given in this paper.

The importance of making all exposures for volume determination in the same heart phase is emphasized. To determine the heart volume, the exposure should be made at the end of diastole, just before the R wave. However, in the investigation of mitral lesions, the exposure should also be done at the end of systole at the dermination of the T wave.

We have been unable to confirm the large volume differences, up to 40 %, between lying and upright positions found by NYLIN.

SUMMARY

In this investigation it has been established that in the upright position a diminution in heart volume proportional to the elevated pulse rate takes place. The authors consider it necessary that all heart volume determinations be carried out with the patient horizontal.

ZUSAMMENFASSUNG

Verff. halten es für notwendig, dass alle Herzvolumenbestimmungen in liegender Stellung vorgenommen werden. Durch Versuche wurde festgestellt, dass in aufrechter Stellung eine dem Steigen der Pulsfrequenz proportionale Abnahme des Herzvolumens stattfindet.

RÉSUMÉ

Les auteurs estiment nécessaire de faire toutes les déterminations du volume du cœur en position couchée. Des essais ont permis de constater qu'il se produit, dans la position debout, une diminution du volume du cœur, proportionelle à l'augmentation de la fréquence du pouls.

BIBLIOGRAPHY

ASMUSSEN, CHRISTENSEN, NIELSEN: Skand. Arch. Phys. 81: 190, 1939.
COMEAU, WHITE: Am. J. Roentg. 47: 678 1942.
COTRIM: Am. J. Roentg. 47: 377, 1942.
DIETLEN: Dtsch. Arch. klin. Med. 97: 132, 1909.
HILL: J. Physiol. 18: 15, 1895.
HODGES, EYSTER: Am. J. Roentg. 12: 252, 1924.
HUBACHER: Radiol. Clin. 15: 70, 1946.
JONSELL: Acta Radiol. 20: 325, 1939.
JONSELL, SJÖSTRAND: Acta Phys. Scand. 3: 49, 1941.
KAHLSTORF: Fortschr. Röntg. 45: 123, 1932.
—: Klin. Wschr. 17: 223, 1938.
—: Klin. Wschr. 12: 262, 1933.
LAURELL: Fortschr. Röntg. 53: 501, 1936.
LINDHARD: Skand. Arch. Phys. 30: 395, 1913.
LYSHOLM, Acta Radiol. 7: 189, 1926.
LYSHOLM, NYLIN, QUARNÅ: Acta Radiol. 15: 237, 1934.
MEEK: Am. J. Phys. 70: 385, 1924.
MORITZ: Dtsch. Arch. klin. Med. 82: 1, 1905.
—: Dtsch. Arch. klin. Med. 176: 455, 1934.
NYLIN: Skand. Arch. Physiol. 69: 237, 1934.
—: Nordisk Med. Tidskr. 10: 1139, 1941.
NYMAN: Studien über die Atropingruppe. Diss. med. Stockholm 1942.
ROESLER, H.: Clinical Roentgenol. of the Cardiovascular System. London 1936.
—: Am. J. Roentg. 32: 464, 1934.
ROHRER: Fortschr. Röntg. 24: 285, 1916/17.
SALATHÉ: Trav. d. Laborat. de Marey 3: 261, 1877.
SCHNEIDER, CRAMPTON: Am. J. Phys. 110: 14, 1934.
ZDANSKY, E.: Röntgendiagnostik des Herzens und der grossen Gefässe. Wien 1939.

FROM THE NEUROROENTGENDIAGNOSTIC LABORATORY (HEAD: OLLE OLSSON, M. D.) AND THE DEPARTMENT OF NEUROSURGERY (TEMPORARY HEAD: NILS LUNDBERG, M. L.), UNIVERSITY CLINIC, LUND, SWEDEN

THORACAL AORTOGRAPHY BY CATHETERIZATION FROM THE RADIAL ARTERY[1]

Preliminary report of a new technique

by

Stig Radner

Abdominal aortography with the technique applied by Dos Santos and his school represents a valuable method in the diagnosis of several abdominal conditions. It is now in general use in the medical centers.

In the last few years also thoracal aortography has gained the interest of the clinician. With recent progress in surgical technique the major anomalies of the great vessels at the base of the heart, such as coarctation of the aorta and patent ductus arteriosus, are rendered potentially amenable to surgical cure. In the preoperative investigation of these cases the visualization technique of Robb and Steinberg is of great importance. This technique consists of rapid intravenous injection of 20—40 cc. of 70 per cent diodrast solution and the making of roentgenograms at the arrival of the solution in the successive cardiovascular structures.

As to the visualization of the thoracic aorta the Robb and Steinberg method seems to present some disadvantages. It is reported by these authors that in about one quarter of all cases the thoracic aorta is not sufficiently visualized. Furthermore, some of the cardiovascular disturbances encountered in this technique are considered by the authors to depend on the direct action of the diodrast solution on the walls of the heart cavities. The disadvantages mentioned are due to the indirect character of the aortographic technique, the contrast solution being transported and diluted by venous blood stream.

Since March 1947, a new technique for the visualization of the thoracic aorta has been used in our clinic. In order to avoid the long preaortic route the radiopaque solution is injected directly into the ascendent aorta.

[1] Submitted for publication, Dec. 20, 1947.

Technique

With the patient in recumbent position on the Roentgen-ray table, the radial artery on the right or left side is exposed and ligated in the upper third of the forearm. A strangulating sling is placed proximally to the ligature and a small cut is made in the isolated part of the artery. Through the cut a catheter, size nr. 7—9, is introduced in retrograde direction. By successive introduction under fluoroscopic control the catheter is guided via the brachial, axillar and subclavian artery into the ascendent aorta.

The patient then is placed in convenient position and about 30 cc. diodrast, 50 or 70 per cent, are injected as rapidly as possible. Three exposures are made: after injection of 20 and 30 cc. and one second after completion of injection.

Fig. 1. Catheter introduced into the bulb of the aorta and diodrast injected through the catheter. The ascendent aorta, the arch with all three brachiocephalic branches and the descendent aorta are visualized.

To avoid clotting in the catheter it is necessary to have an infusion set with normal saline and heparin solution.

No reaction to the injection was recorded on simultaneous cardiovascular examination, including electrocardiography, with the exception of slight and transient tachycardia.

Owing to the paucity of adequate material for investigation there is

so far only a rather limited experience of this direct technique in our clinic. Therefore, after some few but promising trials, the best result of which is seen in the figure, the technique was recommended to other departments with more abundant material for more extensive testing and use. The results of our continued investigations with the technique will be published later.[1]

SUMMARY

The author reports a new technique for visualization of the thoracic aorta. A catheter is introduced into the radial artery and guided under radioscopic control via the subclavian artery into the ascendent aorta. After the rapid injection of 30 cc. diodrast exposures of the aorta are made.

ZUSAMMENFASSUNG

Der Verf. beschreibt eine neue Methode zur Kontrastdarstellung von der Brustaorta. Ein Katheter wird in die Art. radialis hineingeführt und von dort aus unter Durchleuchtungskontrolle via Art. subclavia in die Aorta ascendens hinuntergeführt. Nach schneller Injektion von 30 Kubikcentimeter Diodrast werden Röntgenexponierungen von der Brustaorta vorgenommen.

RÉSUMÉ

L'auteur décrit une méthode nouvelle d'examen radiologique de l'aorte thoracique. Une sonde est introduite dans l'artère radiale et, de là, dirigée, sous contrôle radioscopique, via l'artère sous-clavière, jusque dans l'aorte thoracique. Après injection rapide de 30 cc de diodraste l'aorte thoracique est radiographié.

REFERENCES

RADNER, S.: Acta radiologica 1945, 26, p. 497.
—, Acta radiologica 1947, 28, p. 838.
ROBB and STEINBERG: Journ. Clinical Investigation 1938, 17, p. 507.
DOS SANTOS, LAMAS and CALDAS: Bull. et Mém. Soc. nat. de Chirurgie, 1929, p. 587.

[1] The technique is already shortly indicated by the present author in a paper in this journal, 1947.

FROM THE I. ROENTGENDIAGNOSTIC DEPARTMENT OF SÖDERSJUKHUSET, STOCKHOLM
(CHIEF: DOCENT G. JÖNSSON).
IN COOPERATION WITH THE II. MEDICAL CLINIC OF SÖDERSJUKHUSET, STOCKHOLM (CHIEF: PROFESSOR G. NYLIN), AND THE SURGICAL CLINIC OF SABBATSBERG'S HOSPITAL, STOCKHOLM
(CHIEF: DOCENT CL. CRAFOORD)

THORACIC AORTOGRAPHY[1]

Preliminary report

by

B. Brodén, H. E. Hanson and *J. Karnell*

Coarctation of the aorta and patent ductus Botalli are vascular malformations that nowadays to a great extent can be operated upon. Correct indications and a correct planning for the operation need a diagnosis that amongst other things contains a detailed anatomic investigation of the vascular malformation in question.

In the case of *coarctation of the aorta* the surgeon must know the position and the length of the coarctation. He must also know the appearance of the aorta above and below the coarctation, the distance between the coarctation and the left subclavian artery and also the dislocation of the aorta by the insertion of lig. Botalli. The ordinary roentgen examination can only give incomplete information about these anatomic details. — In cases where an interarterial communication between the aorta and the pulmonary artery definitely has been proved but where the diagnosis of a *patent ductus Botalli* in no other way could be shown because of atypical clinical findings one needs other diagnostic aids to localize the communication. In this way an unnecessary explorative thoracotomy can be avoided.

Angiocardiography is a method of contrast roentgenography that gives detailed anatomic information about the heart and the great vessels originating from the heart. An opaque solution is injected into a cubital vein (MONIZ, DE CARVALHO and SALDANA 1932, CASTELLANOS, PEREIRAS and GARCÍA 1937, ROBB and STEINBERG 1938) or through a catheter inserted through the jugular vein and the superior vena cava into the right auricle (CHAVEZ, DORBECKER and CELIS 1947). In most cases one can get detailed roentgenograms also of the aorta and its greater

[1] Submitted for publication, Dec. 20, 1947.

intrathoracic branches with this method, but in quite a few cases the visualization of the aorta is difficult, the causes being as follows:

1) Insufficient concentration of the opaque substance, as it is diluted during the passage through the heart and the pulmonary vessels. This may occur especially in cases of enlarged heart where there is a greater amount of residual blood. It may be due to stasis in the pulmonary circulation, or to a left to right shunt where the dilution begins in the right chambers of the heart. Finally it may be due to aortic incompetence where regurgitation of the dye into the large left ventricle occurs.

In all the above cases an unsatisfactory visualization of the left chambers and of the aorta can be expected.

2) When the opacity has reached its maximum in the aorta there is still so much opaque substance left in the pulmonary vessels, that it makes the outlines of the aorta difficult to distinguish. This reason makes it also difficult to see a pathological communication between the aorta and the pulmonary artery.

3) When the contrast substance passes the pulmonary circulation the patient can sometimes not avoid coughing. This brings about a risk of badly defined roentgen films.

4) As the number of roentgenograms has to be limited partly because of the risk for the investigators and the technical assistants, and partly to avoid overcharging of the roentgen tube, one must know at what moment after the injection the opacity of the aorta has reached its maximum. There is no simple and sufficiently safe method of estimating this moment.

All these difficulties in evaluating the aorta that can show up at an angiocardiography, can be avoided if the radioopaque substance in sufficient concentration is injected directly into the aorta. CASTELLANOS and PEREIRAS (1939) have described a method for counter-current aortography injecting an opaque solution into the left brachial artery. This way they have been able to show patent ductus Botalli in children. (Whether this method can be used also on adults is not obvious in the works we have been able to get from these authors.) NUVOLI (1936) has injected contrast substance through the sternum after puncture of the ascending aorta in order to investigate aneurysm. RADNER (1945) has used a similar method of investigating the coronary arteries. In a short summary of a communication presented at the Second Inter-American Congress of Cardiology (1946) a new method for aortography used by DEL CAMPO and HOYOS »by means of direct injections of opaque solutions into the aortic arch» is mentioned. We have been able to find no other publication than this short statement about the method.

RADNER (1947) has carried out a method of arterial catheterisation and found that an uretheric catheter inserted in the radial artery, can be manipulated into the aorta. Furthermore RADNER has proved that by injecting contrast substance into the catheter it is possible to perform an aortography. We have used this method (published by RADNER in this journal simultaneously with our work) modified to a certain extent, in three cases. They will be reported upon here later.

Technique

Premedication: Barbiturate compounds, morphia and scopolamine and papaverine are given. A small amount of the contrast solution is injected intravenously to determine if the patient has allergic reaction.

The examination is performed with the patient lying down. After a local anaesthesia the radial artery is exposed in the fossa cubiti. The artery is occluded by two clamps. Between these a small transverse incision is made. A heart-catheter 8—9 F is inserted in the vessel and the clamps are removed. The catheter is guided to the aorta under fluoroscopic control. It is washed through continuously with a saline solution. In order to delay the transport of the contrast substance from the thoracic aorta, the abdominal aorta is compressed with the same contrivance used for compression of the urethers at urography and the opposite arm is equipped with a pressure cuff filled above the systolic pressure. 50 ccs. of a 70 % solution of Diodrast is injected with an ordinary syringe as fast as possible. Roentgenograms are made in two perpendicular directions simultaneously and at a speed of one pair of films a second. Exchange of cassettes and exposure is performed automatically.

In one case the catheter was inserted through the left radial artery. It then went spontaneously into the descending aorta but was easily manipulated into the ascending aorta. In the other two cases the catheter was inserted through the right radial artery. In one of these cases there were difficulties in guiding the catheter because of a spasm little affected by spasmolytic or other drugs with dilatating effect. In this case the examination would no doubt have been simpler with anaesthetic. In none of the three cases has there been any bleeding after removal of the arterial clamps. In two of the cases the arteries could be closed by continuous suturing and in one the artery had to be ligated. This caused no complications. The injection of the contrast medium met with great resistance: in all three cases the injection took 7 seconds.

The patients have had no other subjective inconveniences than a feeling of heat in the head of short duration. Blood pressure and the pulse rate taken before and after the injection were not affected.

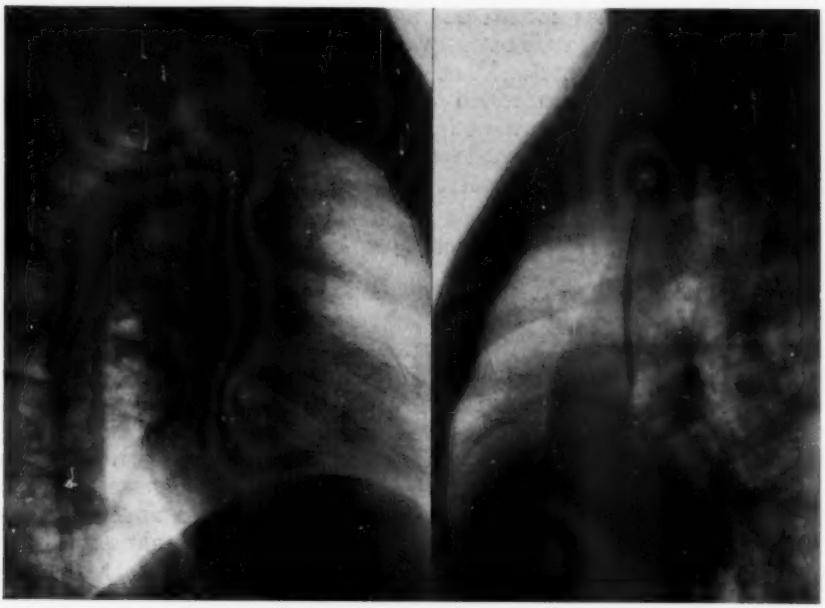


Fig. 1. Fig. 2.

Fig. 1, Case 1. Normal aorta.
Fig. 2, Case 2. Coarctation of the aorta. Typical localization of the stenosis.

Reports of cases

Case I. Labourer, 26 years old, diagnosis congenital heart disease. Heart catheterization with gas analysis suggested the diagnosis of patent ductus Botalli. No continuous murmur could be heard or recorded, wherefore the diagnosis became uncertain. As the patient's troubles were of such a degree as to warrant the possibilities of an operation, we considered an aortography indicated.

Roentgen examination: No enlargement or deformation of the heart. The pulmonary artery which seems to be wide makes pulsations of great amplitude.

Aortography: The catheter is inserted through the right radial artery with the tip lying in the aortic arch near the origin of the innominate artery. Six seconds after the injection of the contrast substance began, the maximal opacity has reached the aortic arch, the descending aorta and the great arteries originating from the aortic arch (Fig. 1). The aorta is of ordinary width and shape. No communication between the aorta and the pulmonary artery can be found.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3, 4, 5, Case 3. 9, 10, 11 seconds after beginning of injection. Coarctation of the aorta. Typical localization of the stenosis. The distance between the stenosis and the left subclavian artery is 3 cm. Anterior to the stenosis there is a vessel outlined by the opaque medium going antero-caudally — patent ductus Botalli? (Fig. 4.)

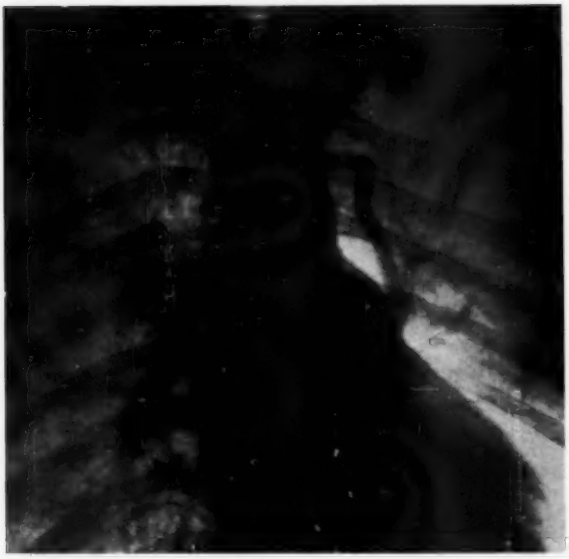


Fig. 6, Case 3. The widened internal mammary arteries 10 seconds after injection. Intercostal arteries are also visualized.

Case II. Labourer, 19 years old with typical clinical findings indicating coarctation of the aorta. Indications for operation were present. At an angiocardiography the aorta could not surely be defined, wherefore an aortography before the operation was considered necessary.

Roentgen examination: The left ventricle is moderately enlarged (volume per square metre body surface 490 ccs.). In the aorta is a deformation typical of a coarctation. There is widening of the sulci costales on the lower edges of the ribs.

Aortography: The catheter is inserted through the left radial artery. Its tip lies in the ascending aorta near the orifice. The opacity reached its maximum in the thoracic aorta and branches 7 seconds after the beginning of the injection. The ascending aorta and the aortic arch are of ordinary width. The coarctation has a typical situation. The left subclavian artery cannot be distinguished (the film is overexposured). The aorta is somewhat widened below the coarctation.

Case III. Married sales-woman 23 years old. 2 normal deliveries. The diagnosis congenital heart disease was made in her childhood, but as the patient did not experience any subjective symptoms, no further investigations were made. The coarctation was discovered at a roentgen investigation of the lungs.

Results of examination:

In good general condition. *Cor:* Marked pulsations in the episternal notch and in the neck. Signs of well developed collateral circulation. Harsh systolic murmur maximal over the base. A_2 is accentuated. In the third intercostal space on the left side a soft diastolic murmur is heard during the whole of diastole. *Blood pressure:* Arms systolic 190, diastolic 110—105. Legs systolic 160, diastolic 130. The blood pressure in the arms varies during the 24 hours and falls at night to 110/65 at the lowest. *Tonoscillography* (EJRUP): Shows lower blood pressure in the legs than in the arms and an abscence of the pulsations after average work. *E. C. G.* at rest and after work, nothing remarkable seen. *Hypoxemia E. C. G.:* after 10 minutes hypoxemia. *Heart function test according to Nylin:* Insufficient for heavy work (10/208). *Eyegrounds* (GRANSTRÖM): Arteries of about normal width but obviously tortuous and show light wavelike diameter variations like those found at coarctation of the aorta. *Clinical diagnosis:* Coarctation of the aorta + patent ductus arteriosus? *Roentgen examination:* Changes typical of coarctation of the aorta are present: indentations in the left border of the superior mediastinum, and widening of the sulci costales on the lower edge of the ribs. The heart is not enlarged (volume per square metre body surface 350 ccs.) and has no obvious pathological shape.

Aortography: The catheter is inserted through the right radial artery. Its tip lies in the aorta at the origin of the innominate artery. The opacity in the aorta and its intrathoracic branches has reached its maximum on the films taken 9—11 seconds after the beginning of the injection. The vessels appear very clearly (Fig. 3—6). The ascending aorta and the aortic arch are of ordinary width. The coarctation is situated at the insertion of the ductus Botalli. The distance between the coarctation and the left subclavian artery is 3 cm. In front of and next to the coarctation there is a straight 2 cm. long opaque vessel going antero-caudally — patent ductus Botalli? The subclavian and internal mammarian arteries are considerably widened on both sides. The intercostal arteries are widened and tortuous. — The observation made in this case that the left subclavian artery originates as far from the coarctation as 3 cm. is specially interesting because GLADNIKOFF (1946) considers that »the left outline of the superior mediastinum with the part convex to the left is, down to the indentation, formed by the dilated left subclavian artery». GLADNIKOFF's statement is not applicable to our above related case, as the aortography proves.

We consider the results achieved by aortography in the three related cases so satisfactory that we aim to use this method instead of angiocardiography at contrast roentgenography of vascular malformations in the aorta and its intrathoracic branches — especially at coarctation of the aorta and patent ductus Botalli — but also at more rare conditions, such as dysphagia lusoria. Possibly aortography can also be used to differentiate between aneurysm of the aorta and tumors in the mediastinum. Naturally our cases are too few to estimate the reliability of the method. A technical inconvenience may be that the injection of the radiopaque solution takes too long a time — in our cases about 7 seconds.

We have injected manually with an ordinary syringe. It is possible that the speed can be increased by a suitable mechanical arrangement for injecting. This way the risk of the aorta being insufficiently filled with the contrast medium may be minimized.

SUMMARY

A method for aortography suggested by RADNER and somewhat modified has been used in 3 cases. The authors consider that the method deserves to be preferred to angiocardiography at contrast roentgen examinations of the aorta and its intra-thoracic branches.

ZUSAMMENFASSUNG

Eine von RADNER vorgeschlagene und etwas abgeänderte Aortographiemethode hat in 3 Fällen Verwendung gefunden. Verf. sind der Ansicht, dass diese Methode bei Kontraströntgenuntersuchungen der Aorta und ihrer intrathorakalen Äste der Angiokardiographie vorzuziehen ist.

RÉSUMÉ

Une méthode d'aortographie proposée par RADNER fut utilisée en trois cas, avec de légères modifications. Les auteurs sont d'avis que cette méthode mérite d'être préférée à l'angiocardiographie lors d'examens radiologiques au moyen de substances de contraste de l'aorte et de ses branches intra-thoraciques.

LITERATURE

CASTELLANOS, A., PEREIRAS, R. and GARCÍA, A.: La Angio-Cardiografia radio-opaca. — Arch. de la Socied. de Estud. Clín de la Habana 1937.

CASTELLANOS, A. and PEREIRAS, R.: Counter-current Aortography. — Revista Cubana de Cardiología. Årg. 2: 187. 1939.

CHAVÉZ, I., DORBECKER, N. and CELIS, A.: Valor diagnostico de los Angiocardiogramas obtenidos por Inyección directa intracardíaca a través de una Sonda. — Arch. del Instit. de Cardiología de México. Vol. 17: 121. 1947.

DEL CAMPO, C. G. and HOYOS, J. M.: Angiography of the aorta. — Summary of a communication. — Am. Heart. J. 33: 729. 1947.

GLADNIKOFF, H.: The roentgenological picture of the coarctation of aorta and its anatomical basis. — Acta radiol. 27: 8. 1946.

MONIZ, E., DE CARVALHO, L. and SALDANA, A.: Angiopneumographie. J. de Radiol. et Electrol. Oct. 1932.

NUVOLI, I.: Ref. in Zbl. f. Radiologie 22: 382. 1936.

RADNER, S.: An attempt at the roentgenologic visualisation of coronary blood vessels in man. — Acta radiol. 26: 497. 1945.

—, Intracranial angiography via the vertebral artery. — Acta radiol. 28: 838. 1947.

—, Thoracal aortography by catheterization from the radial artery. — Acta radiol. 29: 178. 1948.

ROBB, G. P. and STEINBERG, I.: A practical method of visualization of the chambers of the heart, the pulmonary circulation and the great vessels in man. — Journal Clin. Investigation 17: 507. July 1938.

FROM THE RADIUM CENTER, COPENHAGEN (CHIEF: JENS NIELSEN, M. D.)

THE INFLUENCE OF CASTRATION BY ROENTGEN ON CARCINOMA OF THE BREAST[1]

by

Viggo E. Thayssen.

Numerous investigations, both clinical and experimental, have been made with a view to getting a clearer understanding of the interdependency which has been found to exist between the secretion from certain endocrinous glands and cancer. Especially has interest been centered about those organs which already physiologically are subject to a strong, partly periodical, hormonal action, — in women the mamma and the uterus, in men the prostate. In recent years, the researches have been concerned particularly with the role of the estrogenic hormones, which, besides their special hormonal action, have shown considerable carcinogenic properties. What has also called for attention is the curious fact that we here have to do with a substance which constitutes a physiologic part of the organism and at the same time possesses an indubitable carcinogenic effect. It has not yet been possible to determine in what manner the estrogen affects the mammary tissue so that the result becomes a malignant transformation of the latter. Thus, it is not known if its action is a direct one, or if the effect is produced via other endocrinous glands (? the hypophysis) or if the estrogen in the organism only develops the mammary tissue to such an extent that other factors then may set in and cause the malignant transformation. It is no doubt necessary, — as pointed out by TANNENBAUM (26), among others, — to distinguish sharply between the outward circumstances that determine the occurrence of cancer in the tissue, and the conditions which may have either an accelerating or an inhibiting influence on a fully developed malignant tumor.

Already in the latter part of the last century, investigators had from clinical, purely empirical considerations come to the supposition

[1] Read at the meeting of the Congress of the Northern Association for Medical Radiology in Copenhagen, June 15th 1946; submitted for publication, June 20, 1947. The study was made with aid from the Danish National Anti-Cancer League.

of a correlation between breast cancer and the function of the ovaries, but only the systematic experiments on animals carried out much later have brought us to the point where we are to-day.

The huge number of experimental researches as a whole lead to the conclusion that the following factors must be contributing to the development of cancer in mice: 1) a hereditary factor; 2) a milk factor; 3) a hormonal stimulation, probably not wholly depending on the estrogenic component; and, 4) diverse extraneous factors, among others temperature and diet, which have also been shown to have some influence.

The other side of the question, how the growth of the fully developed malignant tumor responds to the influence of estrogen and other hormones, has only given rise to relatively few and scattered publications, which on the whole conclude that the tumor growth is only to a small extent influenced by the action of those substances. In accordance with this, I have myself found quite similar results in experiments not yet published.

Clinically, observers began already in the latter part of the last century to realise the existence of a relation between the function of the ovaries and the course of mammary cancer. Thus, already in 1889 SCHINZINGER (24), who had noticed that breast cancer took a much more violent course in young women and during pregnancy than in older ones, proposed »die Damen rascher alt zu machen, dadurch dass wir durch Kastration die Brustdrüsen rascher zur Atrophie bringen und den Krebsknoten die Möglichkeit geben, sich in den schrumpfenden Gewebe abzukapseln». He never got so far as to publish, himself, any results of the treatment thus proposed, and it was BEATSON (4) who, in 1896, presented the first report on the effects of ovariectomy, together with other surgical treatment of breast cancer. AHLBOM (3) has here in the Acta Radiol. 1930 published an excellent historic review on the subject, and to this I will refer. He gives the results of examinations of 163 breast cancer patients with metastases or recurrences treated with roentgen-ray irradiation of the ovaries plus local therapy, together with a control material of 141 patients who had not received ovarian irradiation. As control material, he used, — out of all the patients admitted at the same time for breast cancer, but who had not been roentgen-castrated, — 141 with primarily inoperable tumors or recurrences and metastases after operation, in whom it might then be assumed that the improvement was occasioned by the radiologic treatment. AHLBOM found that there was hardly any essential difference between the course of the disease in the two groups, except for a slight improvement in the patients above the age of 45 years who had been castrated by roentgen rays. Of 16 patients

who had received only this treatment, only one, a woman 68 years old, showed some slight objective, but no subjective improvement. As regards the duration of life of the treated patients and the controls, he says that he found no sure difference, either.

In the last years, the problem has again been the object of increasing interest (Taylor (27); Newcomber (19); Hunt (15); Pohle (21); Ritvo & Petersen (22); Adair, Treves, Farrow & Scharnagel (2)) especially after Huggins (14) had demonstrated the indubitable growth-inhibiting effect of estrogen in the treatment of cancer of the prostate. All these authors find that there is a positive improvement in the disease in about one third of the cases treated, though unfortunately they give no suitable control materials to show prolongation of survival.

Besides the therapeutical castration, certain physiologic and therapeutic conditions under which changes occur in the estrogenic level help one to determine, clinically, the influence of such changes on the development of breast cancer. During the menopause and after, and when the ovaries are destroyed as result of either tumor or inflammation, the production of estrogen becomes reduced; during pregnancy and by the presence of estrogen-producing tumors it becomes increased. About the low estrogen production during the menopause I shall speak in greater detail later on, and as regards the reduction of the production of estrogen when the ovaries are destroyed, such cases are reported in the literature (Adair and coworkers) where it is stated that spontaneous castration produced by metastases from tumors or by inflammation has resulted in improvement in cases of breast cancer. That the greatly increased production of estrogen during pregnancy makes the course of the disease far more serious is a matter of almost universal agreement; still, Mankin (17) believes that he can show that it inhibits the growth of the tumor, and that the latter does not begin to develop immensely until after the pregnancy has been interrupted and the estrogenic level again begins to fall. He therefore believes that the pregnancy of women with breast cancer should be allowed to proceed uninterrupted, and the increased estrogen production be made use of, at the same time as every possible measure is employed to treat the primary affection. The estrone-producing tumors, granulosa-cell tumors and thecomas are by no means altogether rare, and in many cases a connexion has been ascertained between those affections and cancer of the cervix or the body of the uterus. On the other hand, only a single case has been reported of their coincidence with breast cancer (Hoffman (13)).

In 1935, Haddow (9) stated it as his conception of the estrogen's action on the growth of the tumor that when employed in small doses

its effect was accelerating, while in large doses it was inhibitory, analogous to the effect of irradiation with roentgen. The technical development of hormone production, which about at that time began to make rapid progress, made it possible to obtain pure, constant hormone preparations in sufficient quantities, and the result has been that in the last few years numerous clinical studies have been made with a view to finding out how the different female and male hormones affect the course of breast cancer. Thus, it has been found, in accordance with HADDOW's theory, that large doses of estrogen or similar substances in a number of cases improved the condition (HADDOW; WATKINSON & PATERSON & KOLLER (10); EDWARDS (8), and others), especially in the case of patients of advanced age.

By analogy with the effect of castration it has also in recent experiments been attempted to diminish the effect of the estrogen by injection of large doses of testosterone, and also here it has been found that in not a few cases an excellent effect, similar to that of castration, was obtained (LOESER (16); ADAIR & HERMAN (1)).

Also orchiectomy on males with breast cancer has been tried (TREVES, ABELS, WOODARD & FARROW (29)). Six cases, in all, have been reported; 4 of which, all old men, improved, whereas in a man 39 years old the operation had no effect whatever on the symptoms. One man died shortly after the operation, before the effect could be estimated.

At the Radium Center in Copenhagen, several hundred patients were during the period 1934—43 inclusive treated for breast cancer with metastases. Of these, 99 were given both local treatment of the primary tumor and the metastases, and roentgen treatment of the ovaries (i. e. castration by roentgen) at some time or other after the appearance of the metastases; whereas the others got only local roentgen treatment. As there was no particular selection of those who were roentgen-castrated, the non-castrated of the corresponding age classes will serve as an excellent control material. Of the 99 castrated, 72 were roentgen-treated before the menopause (Group I); the remaining 27 in, or until twelve years after the latter (Group II). The youngest patient was at the time of castration 26 years old, the oldest 59. All the patients of the first group had until the time of castration menstruated quite normally, whereas the patients of the second group had either shown signs of incipient climacter or their menses had definitely ceased. In 94 per cent of the cases, the diagnosis of mammary carcinoma had been verified by microscopy; as regards the remaining 6 per cent, the course of the disease established the diagnosis beyond doubt.

To make it possible to measure the improvement resulting from the castration, it is necessary to divide the patients into two groups: »improved» and »not improved». The estimation is made very difficult, however, by the fact that the greater number, by far, had, besides the castration treatment, had local treatment, and, as it seems, with better effect than in the cases where only castration treatment was given. As improved I have in my analysis reckoned all the cases which showed a distinct effect of the roentgen treatment, either complete or partly healing of the skeletal metastases or tendency to healing of the primary tumor or of metastases to other sites than the bones. Besides, the improved have all survived for at least two years after the castration.

The castration was done in the manner that as routine dose 250 r × 2 were given on each of four 10 × 15 cm. fields over the lower part of the abdomen, — two anterior and two posterior, — 180 kv., 15 ma., distance 40 cm. and filter 0.5 Cu. In twenty-four cases 1,000 r were given, however, to 4 fields, but seemingly without greater effect than the other doses. The number of patients castrated in this manner, in proportion to the entire material, was thus the same as the number of improved. In 10 of these cases, the irradiation of the ovaries was repeated from three months to two years after the first treatment. In most of them, the reason for the repetition was that the skeletal metastases had gradually become so extensive that local treatment seemed hopeless, and whether any effect has been obtained is not sure. Only in one case did also the repeated irradiation of the ovaries have a good effect; but as intensive local treatment was given at the same time it is, of course, not impossible that it may in some measure be due also to the latter that the patient's condition has improved so much that even now, 3 years after the last irradiation of the ovaries, roentgen examination does not show any pathologic changes in the formerly metastatically involved spinal column.

At the time when the castrations were done, there were in all the cases metastases; in some of them only to the lymph nodes, but in the great majority both metastases to the latter and distant metastases. In Group I, there were regional lymph node metastases in 28 per cent, distant metastases in 72 per cent, of the cases; in Group II respectively 18 and 82 per cent. As a rule, the castration treatment was instituted when the examination showed that metastases were present, or when the patient's condition clinically was so bad that it seemed warrantable to expose her to the serious psychic trauma which castration must inevitably be for a woman who has not yet ceased to menstruate. In that respect we have been very reserved, despite the many authors (Olch (20), Newcomber (19), Steel (25) who advise

castration in all cases of breast cancer, even when there are no metastases.

Besides the castration treatment, most of the cases were given local treatment, 47 of them *both before and after,* and of these, 49 per cent improved. In the other 52 cases, local treatment was given only before or at the same time as the castration treatment, and of these 19 per cent improved. Of these last fifty-two, 18 were given castration treatment by roentgen only at the time when the metastases developed, after they had before then been treated for their breast cancer. The number of improved in this group is 5 (= 28 per cent). Finally, there are 3 patients who had had no treatment, at all before they were referred to the Radium Center, and who all at the time of admission hade inoperable breast cancer with metastases to the lungs. In all these, the affection had had a duration of about 6 months, and it was the pulmonary symptoms which had caused them to seek medical advice. They were not given local treatment, but were only castrated with our normal dose of 500 r × 4. A later control examination of their lungs showed clearing-up of the formerly veiled areas of the latter, and they improved astonishingly clinically; but only for a relatively short time, respectively 6, 7 and 13 months.

Table I.

Division according to the Site of the Metastases of the 99 roentgen-castrated Cases into improved and not improved.

	Group I (menstruating)		Total	Group II (in menopause)		Total
	Improved	Not improved		Improved	Not improved	
Skeletal metastases	15 (42 per cent)	21	36	7 (43 per cent)	9	16
Metastases to lungs and liver	3 (16 » »)	16	19	0	6	6
Metastases to other sites	7 (41 » »)	10	17	0	5	5
	25 (35 per cent)	47 (65 per cent)	72	7 (26 per cent)	20 (74 per cent)	27

In my material, I have used as control all the 100 cases of breast cancer with metastases admitted to and treated at the Radium Center during the period 1931—1943 inclusive, and which originally as operable at that time were treated with roentgen, either pre- or postoperatively, in association with radical operation. These patients did not get castration treatment, but were otherwise treated with roentgen rays to recurrences and metastases in precisely the same manner as

the castrated. The average age of these 100 patients was 45.6 years, corresponding to an average age, for the 99 castrated of 43.5 years. In comparing these two groups, I shall take it that the course of their breast cancer after metastases or recurrences had set in would be precisely the same unless it was changed by treatment. As regards the control group, it is easy to determine the exact time of the appearance of the metastases, because, according to our follow-up system, the patients either present themselves or are called in at frequent intervals.

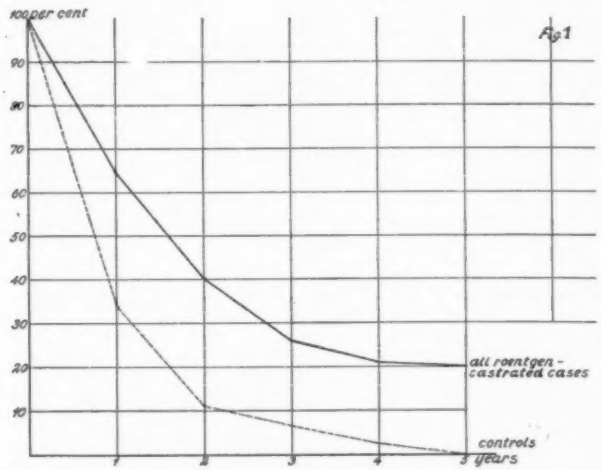


Fig. 1. The 5-years survival of castrated and non-castrated cases, reckoned from the beginning of metastases.

As regards the roentgen-castrated, the question is more difficult, because some of them, — twenty-four, in all, — had been treated elsewhere before they were referred to the Radium Center. In these cases the time of first appearance of the metastases or recurrence has either been determined on the basis of the information contained in the case record, if the latter stated anything positive on the subject, or else it has been reckoned from the date of admission.

The curve (Fig. 1) shows the length of survival for both groups up to five years after the appearance of the metastases. It will be seen that of the castrated, 40 per cent have a survival of two years or more, after their appearance, while the corresponding figure for the controls is only 11 per cent. After five years, 20 per cent of the castrated are still alive, while all the patients of the control group have died. If we examine the survival rates for Group I and Group II

separately, we see that Group II only has 22 per cent of survivals o two years or more, but thus still shows some improvement as compare with the 11 per cent for the control group.

As the two materials are not quite identical, because one of them, —the castration group, — includes both patients who have been treated by roentgen only (16), patients operated on surgically without either pre- or postoperative roentgen treatment (9), patients preoperatively roentgen-treated (39) and postoperatively roentgen-treated (35), I have singled out the two last-named categories, — the pre- or post-

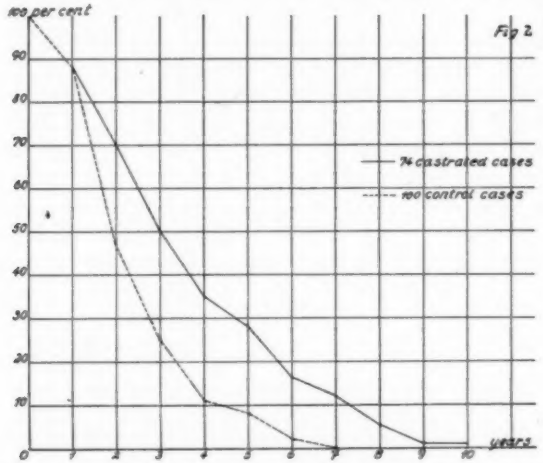


Fig. 2. The 10-years survival of castrated and non-castrated cases, reckoned from the time of operation.

operatively roentgen-treated, — 74 in all, and have compared them (Fig. 2) with the control material's 100 cases (39 preoperatively and 61 postoperatively roentgen-treated); and if we for both groups reckon the length of survival from the time of operation, we also here find a considerably higher survival rate for the castration group than for the control group, especially in the second, third and fourth year. This distribution also to a certain extent shows the transitory effect of the castration treatment, since the two curves again gradually approach each other.

As the castration treatment in part of the cases was not instituted immediately at the time when the metastases manifested themselves, but in some of them not until as long as a couple of years after, it is perhaps not impossible, that it in these cases may have been a question of a more slowly growing tumor. This would make the percentage for

improved» of the castration group somewhat higher. But on the other hand this group includes a number of cases in which, owing to extensive metastases, no local treatment could be given in addition to the castration; and as these bad cases thus must be counted out as far as the control group is concerned, the two factors probably more or less offset one another.

An anamnestic and clinical examination of whether any differences can be found between the two groups: improved and not improved, gives very little result. Familiar disposition to cancer, social position, menopause or childbirths show identical conditions for the two. Neither does it seem to play any role, so far as the effect of the castration is concerned, whether the patient has been treated with roentgen, pre- or postoperatively, or has had only surgical or only roentgenologic treatment. Further, it is found to make no difference whatever, so far as the length of survival following the castration is concerned, whether the latter has been done very shortly after a radical operation or many years after. On the other hand, the microscopic diagnoses may perhaps furnish some slight indication with regard to the chance of improvement, inasmuch as solid carcinoma was found to be the dominating form of the disease among the group of »not improved».

In a number of cases the hemoglobin percentage, the blood precipitation rate and the patient's weight were ascertained in relation to the castration; besides this roentgen examinations were made, and hormone determinations of gonadotropin and estrogen in the urine. In most cases there was a distinct reaction following the castration in the form of higher hemoglobin values, lower precipitation values and increasing weight. In other cases, however, the tests did not give such favorable results, in spite of marked clinical and subjective improvement of the patient. In a great many cases, the castration was followed by objective clinical improvement, the tumor having shrunk and the palpable regional lymph nodes either disappeared entirely or showing marked retrogression. This was the case in 27 per cent of the cases in Group I and in 15 per cent of those in Grop II. Roentgen examination of the metastases before and after the castration showed, for both groups, demonstrable improvement in 18 per cent of the total number of cases.

Urine assays for gonadotropin and estrogen were made before or after castration on 34 patients, all in the menstrual age, and on 3 patients both before and after. In all 79 assays were made, 41 for gonadotropin and 38 for estrogen.[1] About the excretion of estrogen

[1] All the assays were made at the Hormone Laboratory (Chief: CHRISTIAN HAMBURGER, M. D.) of the State Serum Institute in Copenhagen.

it may incidentally be noted that in none of the women did the output exceed 200 M.U. in 24 hours. The distribution of these analyses will be seen from Table II.

Table II.

Showing the Results of the Urine Assays for Gonadotropin and Estrogen before and after Castration.

	Castration by Roentgen				Total
	Before		After		
Gonadotropin	< 50 M. U.	> 50 M. U.	< 50 M. U.	> 50 M. U.	
No. of analyses	27	3	3	8	41
Estrogen	> 20 < 200 M. U.	< 20 M. U.	> 20 < 200 M. U.	< 20 M. U.	
No. of analyses	23	6	1	8	38

All the 3 patients with higher gonadotropin values before the castration had perfectly normal estrogen values (> 20 < 200 M.U.). Neither can these three increased gonadotropin values be taken to be pathologic, since it among thirty assays from normally menstruating women, made at various times during the cycle, must be expected to find some that show a higher output than 50. M.U.

Of the results of the assays for estrogen, the most interesting are the six which showed low values before the menopause, since it would be strange if the effect of the castration in these should be due to a decline in the estrogen values when the output showed the same low values before and after the castration. Of these 6 patients, four belong to the group of not improved, while the other two were decidedly improved. Of one of the latter (patient no. 18736), we have two assays before the castration and four later, until three years after. They all show the same low estrogen values, of less than 20. M. U. output in 24 hours. On the other hand, the assays for gonadotropin furnish a nice expression for the effect of the castration, the output here rising to over 100 M. U. in 24 hours; — in other words to normal postclimacteric values. Thus, in this case the roentgen treatment of the ovaries did not cause any change in the estrogen excretion, which was low already before castration, but had a distinct effect on the excretion of gonadotropin from the hypophysis, — resulting in marked clinical and roentgenologic improvement. (See Figs. 3 & 5; 4 & 6).

After the castration, the urine assays for gonadotropin showed in 8 cases normal postclimacteric values: over 50 M. U. in 24 hours. The 3 assays which showed less than 50 M. U. correspond to the about 5

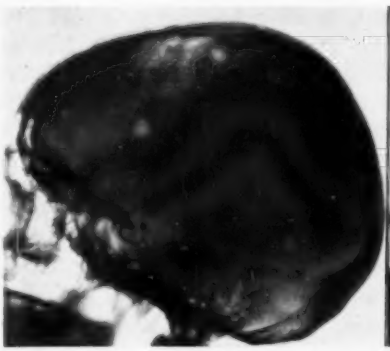


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 3. Cranium before castration. Several clearly circumscribed defects of varying size. (No: 18736.)

Fig. 4. 23 months later. The metastases have nearly disappeared, leaving behind apparently normal osseous tissue and partly tissue, slightly condensed. (No local treatment.)

Fig. 5. Thorax of the same patient. Numerous osteolytic metastases and a spontaneous fracture of a rib.

Fig. 6. 23 months later. The osteolytic metastases are now converted into condensed osseous tissue and the fracture healed.

per cent of assays which also in the case of a normal material would show a gonadotropin excretion of less than 50 M. U. if there has been only a single analysis (HAMBURGER (11)). All the assays for estrogen, except one, showed after the castration an output of less than 20. M. U. in 24 hours, — in other words, normal postclimacteric values. The one which still showed over 20 (but less than 200) M. U. was made barely two months after the castration; which may perhaps account for the output still being so high. The great variations in the amount of estrogenic substances excreted in the course of 24 hours make it impossible to estimate the total estrogen production during a menstrual cycle from the result of a single assay. In order to do so it will be necessary to collect the whole amount of urine produced during a cycle and make the assays from that. Investigations on that basis are at present being made, but are not yet terminated. If also their results should show that the effect of the castration does not necessarily depend on a diminution of the estrogen output, we shall have to alter our present conception, which is based on the estrogen being an essential factor for the growth of the established tumor.

The urine assays made did not show higher values for estrogen in breast cancer patients than in women normally. This accords with the findings of other investigators (ROSS & DORFMAN (23); TAYLOR, MECKE & TWOMBLEY (28)), and it thus seems to be useless to make assays for estrogen and gonadotropin on patients before castration in order to find out whether any effect may be expected from the latter.

As the hormone analyses show, the irradiation of the ovaries caused precisely the same changes in the excretion of gonadotropin and estrogen as those resulting from the woman's entrance in the menopause. That the two conditions nevertheless are not identical is seen, at least, from the difference in their effect on breast cancer. Besides, the excretion of hormones in the urine probably does not give an absolutely reliable picture of the hormonal exchanges in the organism. It is doubtful if the methods of analysis are sufficiently fine to reveal minor variations in the hormone production. Neither is it probable that the difference between the spontaneous menopause and the condition following castration by roentgen is due solely to differences in the production of gonadotropin and estrogen, but that it may be due to changes in the interplay between all the endocrinely secreting glands. That this is so seems all the more likely when we look at two cases of undoubtedly improved patients who had been in menopause respectively 2 and 4 years. Though the estrogen output in both cases, owing to the climacter, was low already before the irradiation of the ovaries, the effect of the castration was excellent in both. This also seems to confirm that the effect of the castration is not altogether du

to the changes in the quantitiy of estrogen. It is hardly possible that the roentgen treatment should have any further effect on the normal, low estrogen value of about 20 M. U. per 24 hours, since we by the assays after the roentgen treatment of the ovaries find values precisely of that order of magnitude. Moreover, the estrogen content of the urine remains at this low level until long up in the senium, no doubt because the excretion now hardly takes place from the ovaries, but from the adrenals. If we study the mortality statistics for breast cancer (Nathanson & Welch (18); Dublin (7); Heiberg & Heiberg (12)), we find that the curve shows an even rise with increasing age, without any drop about the age of the menopause. A morbidity curve for breast cancer recently published by the Danish Cancer Registry (Clemmesen (6)) and based on reports from all the hospitals and physicians of the country, shows, like the curves built on the basis of the death certificates, that the morbidity rate increases with increasing age, but differs from the latter by showing a fall in the number of breast cancer cases for the five-year age group 47—52 years. This corresponds more or less to the average age at which the menopause occurs in Denmark, which is stated by Clausager-Madsen & Ytting (5) to be about the forty-eighth year of life. In this case, there thus seems to be a certain similarity between the menopause and the castration, in their effect on breast cancer. Another factor seems, however, to indicate that their action cannot be of the same character, namely that all investigators have found the improvement resulting from castration to be only temporary; which is very unlike the hormonally quiet, constant state that follows the cessation of the menses.

Considering all this, it is hardly reasonable to suppose that it should be the absolute changes in the estrogen, or the elimination of the estrogenic function, that are the active, determining factors for the results of the castration; all the more since it is possible also in men to bring about an improvement in the course of a mammary cancer by sterilisation. It has been found that the administration of estrogen and testosterone in very large doses has an inhibitory effect on the course of the disease similar to that of castration, whereas small doses of the same endocrine preparations have no effect, or perhaps even an accelerating. To obtain an effect on the tumor growth, it thus seems that the interplay of the endocrine factors may be submitted to a kind of »shock action», which for a time prevents their co-ordination. When the latter after a certain time of reaction has become restored, the conditions for the continued growth of the tumor will again be present, and the recurrence will set in. This would also explain the temporary effect of the castration. Against this theory it might perhaps be objected, though, that it is difficult to see how the »shock effect»,

if it is brought about through the elimination of the estrogen, is to be explained in the cases where an effect of the castration is obtained in patients in menopause, in whom the estrogen values are already low. In that case it must be supposed that there perhaps in the ovaries are other hormones, as yet unknown, whose mode of excretion becomes altered; or else that some nervous reflex, perhaps excited through changes in the vascularisation, causes alterations in the secretion of other endocrine glands, the mode of whose excretion has not been controlled at the same time.

As regards the indications for castration treatment, it seems to me that it should first of all be remembered that the benefits of such treatment are only temporary, and that repetition, later, of the irradiation of the ovaries will hardly produce any further effect. The therapy should therefore be used only as a last resort, in cases where metastases appear or radical operation is impossible. Several authors have held that even if the result is only that it prevents further pregnancies, castration should be used as routine procedure in all women with breast cancer who are under the menopausal age. Others have advocated its use simultaneously with radical operation, and have reported good results of such combined treatment. But if the surgical operation has been successful, a great many patients will continue to live and never have any recurrences, and at best the castration will have been unnecessary; while, if the operation has not been successful and metastases appear later, one will already beforehand have cut oneself off from the possibility of helping the patient by irradiation castration. On the other hand it seems to me to be wrong to subject the patient to the additional trauma of a surgical operation if there are inoperable metastases at the time when the latter is contemplated. In such cases it will be better to treat the affection locally with as large doses of roentgen as possible and at the same time, or shortly after, to castrate. As to whether this roentgen treatment of the ovaries should be employed quite independently of whether the patient is under or past the menopausal age there are still differences of opinion. To judge from the results reported so far, roentgen-ray castration should be employed in all inoperable cases where the woman is still menstruating or is passing through the menopause, and at least eight to ten years after the beginning of the latter.

It must be admitted that the castration therapy is not certain to prove effective, but it may be concluded that in one-third of cases it will result in temporary improvement of the patient's condition, and sometimes in almost miraculous, apparent cure. It may thus be the means of obtaining for the patients some years more of life in relative comfort; all the more as it seems that the castration also has the effect

of prolonging life somewhat, in some cases for as long as up to five years.

It has not been possible to demonstrate any anamnestic or clinical difference between the cases which are improved by castration treatment and those which do not react to that therapy; neither have the results of the assays for gonadotropin and estrogen been of any help in that respect. It is thus impossible either from the age of the patient, from the microscopical picture of the tumor or from the excretion of hormones in the urine to predict with any degree of certainty which cases will react favorably to the castration treatment.

SUMMARY

After a brief historical review of the subject, the author presents a material from the Radium Center in Copenhagen, of 99 breast cancer cases with metastases or recurrences, all of which were treated with roentgen-ray irradiation of the ovaries, resulting in improvement in one-third of them. A comparison with 100 control cases which were not subjected to castration therapy by roentgen shows that 40 per cent of the castrated were still living 2 years after the appearance of the metastases as against only 11 per cent of the controls. Of 74 pre- or postoperatively roentgen-treated and castrated, 28 per cent were alive 5 years after the operation, as against 8 per cent of the controls. On the basis of 79 urine assays for gonadotropin and oestrogen it is shown, among other things, that the castration may have a highly beneficent effect even in cases where the estrogen output was low also before the castration.

ZUSAMMENFASSUNG

Nach einer kurzen diesbezüglichen geschichtlichen Übersicht legt Verf. ein Material aus der Radiumzentrale in Kopenhagen vor, bestehend aus 99 Fällen von Brustkrebs mit Metastasen oder Rezidiven, alle mittels Röntgenbestrahlung der Ovarien behandelt, mit dem Ergebnis von Besserung in einem Drittel der Fälle. Der Vergleich mit 100 Kontrollfällen, die nicht mit Röntgenkastration behandelt wurden, zeigt, dass 2 Jahre nach dem Auftreten der Metastasen 40 % der Kastrierten noch am Leben waren, gegen nur 11 % der Kontrollen. Von 74 prä- und postoperativ Röntgenbehandelten und Kastrierten, waren 5 Jahre nach der Operation 28 % am Leben, gegen 8 % der Kontrollen. An Hand von 79 Harnuntersuchungen auf Gonadotropin und Östrogen wird u. a. nachgewiesen, dass die Kastration, selbst in Fällen mit geringer Östrogenausscheidung auch vor derselben, von sehr wohltuendem Einfluss sein kann.

RÉSUMÉ

Après une courte revue historique du sujet, l'auteur présente un matériel du Centre du Radium de Copenhague, consistant en 99 cas de cancers du sein avec métastases ou récidives, qui furent tous traités par irradiation des ovaires aux Rayons Roentgen, ce qui amena une amélioration chez un tiers d'entre eux. La comparaison avec 100 cas de contrôle qui ne furent pas soumis à ce traitement par la castration montre que 40 pour cent des malades castrées vivaient encore deux ans après l'apparition des métastases, contre seulement 11 pour cent du groupe de contrôle. Sur 74 femmes traitées avant ou après

l'opération par les Rayons Roentgen et castrées, 28 pour cent étaient en vie cinq ans après l'intervention chirurgicale, contre 8 pour cent chez les autres. La recherche de la gonadotropine et de l'oestrogène dans 79 urines permet à l'auteur de montrer, entre autres choses, que la castration peut avoir un effet éminemment bienfaisant même dans des cas où la quantité d'oestrogène était faible déjà avant la castration.

LITERATURE

1. Adair, F. E. & Hermann, J. B., Ann. Surg. *123:* 1023—1029, 1946.
2. Adair, F. E., Treves, N., Farrow, J. H. & Scharnagel, I. M., J. A. M. A. *128:* 161—167, 1945.
3. Ahlbom, H., Acta radiol., *11:* 614—635, 1930.
4. Beatson, G. T., Lancet, *74:* II, 104—107 & 162—165, 1896.
5. Clausager-Madsen, L. & Ytting, H., Nord. med., *16:* 3677—3681, 1942.
6. Clemmesen, J., Ugesk. f. læger, *108:* 905—906, 1946.
7. Dublin, L. I., cit. Geschickter, C. F., »Diseases of the Breast», Philad., J. B. Lippincott & Co., 286, 1945.
8. Edwards, E. T., Brit. M. J., *86:* 490, 1943.
9. Haddow, A., Nature, *136:* 868—869, 1935.
10. Haddow, A., Watkinson, J. M. & Paterson, E., Addendum by Koller, P. C., Brit. M. J., *139:* 393—399, 1944.
11. Hamburger, C., Maanedssk. f. prakt. lægegerning & soc. med., *25:* 41—71, 1947.
12. Heiberg., B. & Heiberg, P., Acta chir. Scandinav., *83:* 479—496, 1940.
13. Hoffmann, J., »Female Endocrinology Including Sections on the Male». Saunders, 1944.
14. Huggins, C., Science *97:* 541—544, 1943.
15. Hunt, H. B., Radiology, *34:* 235—238, 1940.
16. Loeser, A. A., Lancet, *241:* II, 678—700, 1941.
17. Mankin, Z. W., Arch. f. klin. Chir., *199:* 337—393, 1940.
18. Nathansson, I. T. & Welch, C. E., Am. J. Cancer, *28:* 40—53 1936.
19. Newcomber, E., Radiology, *32:* 161—170, 1939.
20. Olch, I., Am. J. Cancer, *30:* 563—566, 1937.
21. Pohle, E. A., Am. J. Surgery, *54:* 490—493, 1941.
22. Ritvo, M. & Peterson, O. S., Am. J. Roentgenol., *51:* 220—229, 1944.
23. Ross, M. & Dorffman, R. I., Cancer Research, *1:* 52—54, 1941.
24. Schinzinger, K., München. med. Wchnschr., *36:* 1724—1725, 1905.
25. Steel, D., Radiology, *26:* 700—705, 1936.
26. Tannenbaum, A., Cancer Research, *4:* 678—682, 1944.
27. Taylor, G. W., Surg., Gynec. & Obst., *68:* 452—456, 1939.
28. Taylor, H. C., Jr., Mecke, F. E. & Twombly, C. H., Cancer Research, *3:* 180—192, 1943.
29. Treves, N., Abels, J. C., Woodard, H. Q. & Farrow, J. H., Surg., Gynec. & Obst., *79:* 589—605, 1944.

FROM THE ROENTGEN CLINIC OF THE TOWN AND COUNTY HOSPITAL, VIBORG, DENMARK
(CHIEF: KRISTIAN OVERGAARD, M. D.)

PROTRUSION OF THE ACETABULA AS COMPLICATION OF LABOR[1]

by

Jens Petersen

Among the many affections that may complicate the course of labor, pelvic deformities play a not inconsiderable rôle and have therefore, of course, been the object of much and thorough study. Yet there has not until now been published any case in which protrusion of the acetabula was the cause of the difficulty; probably because this condition has hitherto been rather unnoticed as a factor in connexion with obstetrics, for the reason that it formerly was observed only in elderly females and not until recent years has been ascertained also in young women. The possibility that it might aggravate a delivery was, however, mentioned already by KULIGA in 1905, and later, in 1935, by OVERGAARD, and has since been confirmed by a case observed in our service in 1944.

The patient was a married woman, aged 32, admitted to our surgical service June 16th to June 24th, 1944, with the diagnosis: prolonged parturition, protrusion of the acetabula into the pelvis minor. The case record notes that she had always been in good health; she was a primipara; menstruations regular, last time in August, 1943; from which it was expected that delivery would take place by the middle of May. During the pregnancy the patient was well.

The course of the labor: About 36 hours before admission she began to get slight, evenly increasing pains, which at first became satisfactorily stronger, but then again got weaker, wherefore she about 24 hours before admission was given thymophysin, with good, but short-lasting effect. She was then given morphia for the night, after which she rested fairly well. As the parturition still did not progress, she was admitted the following morning. The liquor amnii had passed about 24 hours before.

At admission the uterus was found longitudinally ovoid, extending to 3—4 fingers' breadth from the ensiform process. The resistance was greatest in the left side, where the heart sounds were heard well. The head of the fetus could just be felt above the brim of the pelvis. As there were only slight pains at intervals of about ten minutes. 0.3 cc. of thymophysin was given with good effect, but as the pains again became weaker the same dose was repeated after about 3 hours. Two hours later the patient began to bear down, but after about 3 hours the bearing down pains again decreased, therefore another 0.3 cc. of thymophysin was given, and shortly afterwards a living male child was under chloroform anesthesia delivered in 1st vertex presentation.

[1] Submitted for publication, June 24, 1947.

Examinations

Urine, nothing abnormal. Hemoglobin (Sicca) 88 per cent. Wassermann negative. Gonococcus test negative. Blood pressure 140/85.

External pelvic measurements: 27 × 30 × 20½ cm.

Examinations on the couch: The pelvis considerably contracted in all directions, also from side to side, where both acetabula are found distinctly projecting. Conjugate diameter about 9 cm.

Roentgen examination of the abdomen (Fig. 1) shows a fetus in cephalic position, with back towards the right. The head shows rather strong adaptation of the bones and stands with a rather large segment below the pelvic inlet. There is seen a distinct protrusion of both acetabula, with projection into the pelvic lumen of about 1 cm. on the right side, a little less on the left.

At measurement of the pelvis (by the simple geometric method) the inward bulge of the acetabula is distinctly seen in the pelvic roentgenographs taken in axial projection (Fig. 2). The largest diameter of the head of the fetus corresponds more or less exactly to the distance between the acetabula; but owing to the protrusion there may in reality be some difference, because the head may be relatively more enlarged than the pelvic measurement. The measurements are:

Antero-posterior diameter	7.9 cm.
Right oblique »	11.9 »
Left » »	11.9 »
Transverse »	13.1 »
Smallest distance between the acetabula	10.2 »

Roentgenologic diagnosis: Pregnancy, pelvic measurement, osteo-asthenic protrusion of the acetabula.

The child was born at term. Its crying after birth was hardly audible, it lay rather inanimate, whimpering rhythmically and monotonously, but picked up after ingift of 1 cc. of nicordamin and kvitasol. Weight, 3,900 grams, length 52 cm. There were pressure traces both on the left frontal bone, posteriorly, close to the coronal suture, and on the right side, corresponding to the bregmatic bone, close to the lamboid suture. The head was strongly accommodated, with bones of the skull overlapping. (Cranial measurements were not made.)

Epicrisis: We thus have here a case of a primipara, aged 32, in which the course of the parturition, even considering her age, was rather protracted (about 45 hours), and in which both the clinical and the roentgenologic examinations, as well as the pressure traces on the skull of the child, make it probable that the protraction was due to protrusion of the patient's acetabula.

Follow-up examination (April 21st, 1947): There is no history of hip diseases in the family. The patient has four sibs, all healthy; three sisters have children who were born at home, per vias naturales and without complications. The patient herself has always menstruated regularly. When nineteen or twenty years old she had her adenoids removed, when twenty-four or twenty-five she had a peritonsillar abscess incised; otherwise she has always been perfectly well. She has never had any difficulty in walking, nor, for that matter, any troubles whatever referable to the hip joints. Her affection was not discovered until she was admitted to our hospital as related above. *Objective examination* shows distinct restriction of the movements in both hip joints, most so in the left. Especially the rotation and abduction are restricted. There is no pain in moving. *Roentgen*

Fig. 1. General view, June 14th, 1944: Bilateral protrusion of the acetabulum, most pronounced on left side. Distinct overlapping of the cranial bones of the fetus. No sure signs of arthritis deformans.

Fig. 2. Axial view from measurement of the pelvis, June 14th, 1944. (The contours drawn up): The largest diameter of the head of the fetus corresponds very nearly to the distance between the acetabula; otherwise there is no disproportion between the size of the fetal head and that of the pelvis.

examination (Fig. 3) shows the condition on the right side practically unchanged. There is slight protrusion of the acetabula, marked narrowing of the articular interspaces, and the floor of the acetabulum is thin; but there are no signs of arthritis deformans. On the left side the protrusion of the acetabulum is increased about 3—4 mm., also here the articular interspace is narrow and the floor of the acetabulum thin, but there is no sign of deforming arthritis.

Fig. 3. Follow-up examination, Apr. 21st, 1947: The protrusion of the acetabulum on the left side slightly increased; otherwise conditions unchanged.

Protrusion of the acetabulum — or Otto's disease, as the condition is also called after the author who in 1824 first described a bilateral case of it in a macerated pelvic specimen — is an affection the chief feature of which is an abnormally strong dome-shaped projection of the floor of the acetabulum into the small pelvis. It is probably by most believed to be rather uncommon, but especially since the advent of roentgenologic diagnostics the material concerning it has increased considerably, and when it moreover is considered that many cases, either of mild degree with only slightly pronounced symptoms or combined with marked arthritis deformans, have undoubtedly not been reported, there seems to be good reason for thinking that the condition is not as rare as generally supposed. Thus, BRENTRUP, for instance, could in 1943 present 33 cases observed in the course of 10 years in the orthopedic University clinic of Frankfurt a. M.

In order to create a basis for a rational therapy, the studies of this, as of other diseases, have in the first line centered on the clarification of its etiology. A cursory review of the literature shows, as it might be expected, that our present knowledge respecting the manifold etiologic factors contributing to its production has developed little by little. OTTO presumed the condition to be due to an »irregular gout», — a definition which to a certain extent corresponds to our present-day term: arthritis deformans; PONFICK (1872), FÉRÉ (1882) and HALE WHITE (1884) each described a case which they considered as due to tabes. EPPINGER (1903) believed the deformity to be due to growth disturbance in the central part of the acetabulum, a concept which has now, how-

ever, been abandoned. The first case of which the etiology was demonstrated with certainty was published in 1908 by SCHLAGENHAUER, the patient being a woman with protrusion of the acetabulum on one side, developed in connexion with a gonorrhoic coxitis. Since then, other destructive processes have been demonstrated as causal factors, among others tuberculosis (BURCHARDT, 1911), tumors (VALENTIN & MØLLER, 1921) and traumatically determined fracture of the acetabulum (LÖBEL, 1927, SAUPE, 1928). In other cases, where the etiologic diagnosis could not be established with certainty, the affection was conceived to be secondary to juvenile arthritis deformans (SCHERTLIN, 1911), arthritis deformans (KIENBÖCK, 1916), chronic polyarthritis (LÖBEL, 1927), rickets (ZWICKER, 1927), etc.

This summary review shows how the theories respecting the etiology of the disease became more and more numerous, and in a study published in 1927 SAUPE could enumerate not less than twenty such different concepts. No actual attempt at a readily surveyable classification of these was made, however, until 1932, when POMERANZ on the basis of the 79 cases published up to that time proposed a division of them into two main groups: (1) acute cases on infectious basis and (2) chronic cases occurring in connexion with some disease or other (polyarthritis, syphilis, osteomalacia, etc.) and on the whole taking the course of an osteomalacia in the hip joint. This division can hardly be said to be sufficient, however; in the first place because it often will be difficult to separate acute and chronic cases developed on an infectious basis, in the second place because the second group comprises diseases so widely different etiologically as polyarthritis, syphilis, arthritis deformans, osteomalacia, etc.

The etiologically clearest division is the following, suggested by OVERGAARD in 1935.

1. Cases in which it may be directly inferred from the anamnesis that there has been a clearly traceable focal destructive disease either of inflammatory nature or of some traumatic origin. These cases are oftenest unilateral and are by OVERGAARD included under the common designation of »secondary protrusions».

2. Cases in which the disease has appeared without any demonstrable focal cause, and the development of which has been very protracted and insidious. These cases are oftenest bilateral, limited to the acetabulum itself, and the presence of the deformity frequently discovered accidentally. For these cases OVERGAARD uses the designation »primary osteo-arthritic protrusions» or »Otto's disease». In addition to these two groups, OVERGAARD on the basis partly of cases reported in the literature partly of cases observed by himself set up a third group:

3. Cases in which the disease develops in young women at the age

of puberty, with no signs of arthritic changes or focal affections in the hip joint. He considers these to be due to a weakness of the bone tissue, the cause of which cannot be determined but is probably the result of endocrine disorders or late rickets. For this group he suggests the designation »juvenile osteo-asthenic protrusion».

OVERGAARD's classification has been followed by nearly all the later writers on the subject, though none of them seems to make any clear distinction between his second and third groups, but treat all cases falling under them together. The great advantage of his system is that it assembles in one group the not inconsiderable number of cases about the etiology of which there is no doubt, and clearly separates these from all the others. On the other hand, the etiology of the cases which he placed in groups II and III has been and is still, disputed; and with regard to these more recent investigations have brought forward new viewpoints, especially as result of the increasing frequency with which the disease in the last years has been observed in young females.

SCHAAP (1934) was the first to suggest that it might possibly be a question of congenital disease, and the three grounds on which he based his theory were (1) the preponderance of female cases, (2) the great number of cases in which the affection was bilateral, and (3) the fact that, except for slight variations, all the cases presented the same clinical picture. Incidentally, he had already before called attention to the existence of a certain analogy between luxation of the hip joint and protrusion of the acetabulum. He considered the bilateral congenital luxation of the hip joint as a developmental deformity, consisting in an excessive thickness and flatness of the floor of the acetabulum. As support for the theory of a congenital malformation, GICKLER published in 1936 the first report of a familial instance of the disease. BONNET & BREHONT (1938) believed the disease to be conditioned by hormonal disorders, on the grounds that (1) most of the patients were female, (2) the cases were bilateral, and (3) a case treated by castration and parathyroidectomy showed temporary improvement. The basis for their argumentation is feeble, however, especially is the case mentioned under (3) very uncertain.

A more interesting theory is the one propounded in 1939 by HOLDACK, who revived EPPINGER's concept and elaborated it with some striking views respecting the influence of hormonal and endocrine processes. Among other things she says that NIEBER's observation that it specially is in females and feminine types that there roentgenologically can be demonstrated a persistent os acetabuli — *i. e.* an accessory, secondary center in the acetabulum and the other pelvic bones, which does not fuse with its surroundings — draws attention to the importance of the germ cells for the manner in which the ossification of the pelvic bones develops; and further, that the fact that juvenile protrusion of

he acetabulum is almost exclusively found in females on the one hand points to hormonal influence, on the other to endogenous factors, playing a rôle. It is doubtful, however, if the first of these two statements holds good, inasmuch as a review of the literature only shows one instance — BRENTRUP's (1943) case no. 4 — of persisting os acetabuli; and, moreover, the follow-up examination of this case showed the acetabula to be perfectly normal structurally; they were still very deep, but there were now no sure signs of protrusion.

GILMOUR (1939) believed that the disease was due to a disturbance of the normal course of the acetabulum's ossification. The preponderance of female cases he explained as due to the different course of the normal processes of ossification in males and females.

BRENTRUP (1943, 1944) came to the conclusion that all bilateral cases were due to pelvic abnormalities, though the protrusion need not be equally pronounced on both sides. He believed this concept to be justified on the following grounds, already stated by other investigators and now confirmed by himself:

1. The preponderance of female cases (SCHAAP).
2. The large number of bilateral cases (SCHAAP).
3. The uniform appearance of the cases (SCHAAP).
4. The more frequent observation of juvenile cases now than formerly.
5. The familial cases, which likewise are bilateral.

On the basis of a case reported by GICKLER and 2 cases of his own, BRENTRUP particularly stressed the familial character of the disease. This concept seems to be questionable, however, since many published records of cases in which the family history is given, as well as the familial anamnesis in 7 of 14 cases observed in our service do not show familial incidence. Statistically, it seems most likely that the familial occurrence in the three instances named was a coincidence.

As mentioned by OVERGAARD it seems highly probable that abnormal static conditions, as in the case of many other affections of the hip joint, play an important part in the development of protrusion of the acetabulum. Of course, any deviation in the shape of the acetabulum will result in altered conditions of pressure, with resulting possibility of development of pathologic processes. (For the sake of completeness it may be mentioned that changes in the shape of the head of the femur may have similar consequences). This is known also from thorough studies of congenital luxations of the hip joint, which are always considered as being connected with the low and flattened acetabulum. On the basis of this, OVERGAARD, like SCHAAP, stressed the significane of the deep acetabula as an important factor in the development of OTTO's disease. The numerous cases since published have confirmed this view. In all the

cases except those of pronounced bilateral protrusion, there has been protrusion on one side and deep acetabulum on the other. It is characteristic that this has been mentioned and confirmed by all later investigators.

The significance of the static conditions seems also to some extent to explain the prevalence of the disease in females, because the position and architecture of the female pelvis appear to create a greater disposition to it than is the case with the male. It is thus reasonable to suppose that a certain congenital abnormality of the form and structure of the acetabulum plays a part in the development of the disease. Whether this abnormality is determined by genetic, hormonal or endogenous factors, or whether it is merely to be considered as an incidental deviation from the normal, is still an open question.

In reviewing the many cases in the literature one is struck by the frequency with which the disease is combined with changes in the static conditions in the spinal column, especially with increased lumbar lordosis. Already GILMOUR (1939) briefly mentioned this and considered the changes as secondary. It is a question, however, if they are not in fact primary. When a person is standing upright, the hip joint is actually over-extended a few degrees, owing to the anatomic conditions in the joint, so that he is »hanging in the ligaments». A slight change in the angle of inclination of the pelvis, due, for instance, to increased lumbar lordosis, will have a great effect, because a flexion of a few degrees will result in this no longer being the case, and will change the static conditions in the joint considerably, at the same time as the pressure is shifted to a slightly different point of the acetabulum. In this connexion it is worth noticing that the disease, or a disposition to it, seen by the deepness of the acetabula, has only once been observed in a child, but develops at the age when deformations due to excessive static pressure, such as SCHEUERMAN's disease, usually occur. A change in the angles of inclination of the pelvis may probably occur as the result of various diseases in the lower extremities, the pelvis and the spinal column, and as SCHEUERMAN's disease is precisely one which very often results in increased lumbar lordosis, it would be of interest to examine in how many cases it has given rise to protrusion of the acetabulum or to deep acetabula. That SCHEUERMAN's disease is more frequent in males than in females does not exclude that the reverse may be the case with protrusion of the acetabulum; because the position and whole architecture of the female pelvis may play a rôle in that respect. Neither does the circumstance that the development of protrusion of the acetabulum perhaps depends on a change in the static conditions in the hip joint necessarily mean that such a change invariably will result in producing that disease.

Besides the above-named predisposing congenital abnormality of

the form and structure of the acetabulum there must no doubt, however, be some directly causative factor to account for the development, and in view of this it seems justified to maintain OVERGAARD's division of the cases in which there is no traceable focal disease into two groups (II and III), because the provoking factor is undoubtedly very different in young and elderly subjects. The case described in the beginning of this paper clearly shows that the predisposing cause — here the deep acetabula — and even rather strong protrusion of the latter, may be present without giving rise to the slightest subjective symptoms. The fact that protrusion of the acetabulum in elderly subjects nearly always is seen in connexion with arthritis deformans suggests that the latter disease may play a part in the development of the condition, and that this is so is confirmed by the roentgenologic findings, which show that the deforming changes precisely in these cases oftenest are localised to the area where the protrusion is progressing. Thus, the narrowing of the articular interspace and the sclerosis of the joint-surfaces are nearly always found upwards, medially, where the altered conditions of static pressure have the greatest effect, and the same is the case with subchondral cysts. The stages of the pathologic progress in elderly subjects must after this be supposed to be: deep acetabula, altered static conditions, development of arthritis deformans, with protrusion of the acetabula as the final result.

In young subjects the conditions are entirely different. In these the changes are so seldom combined with arthritis deformans that this disease cannot be considered as playing any part as causative factor. Moreover, the roentgenologic picture is, as mentioned by OVERGAARD, slightly different. The protrusion seems to involve a somewhat larger surface and is therefore more likely to cause deformation of the pelvis. One rather has the impression that the condition is more due to a weakness of the osseous tissue, which makes it less resistant not only to normal, but especially to extraordinary demands on it (as in the case of pregnancy). The causes of this apparent weakness of the bone is unknown, but the fact that the condition is almost exclusively found in young females suggests that hormonal or endocrine conditions — and especially changes in these, as, for instance, during pregnancy — may perhaps play a not inconsiderable part.

As regards the obstetric importance of the disease it is evident that the cases falling under OVERGAARD's first group, owing to the deformation of the pelvis may present a serious complication in parturition and delivery. Still, they are in this respect less important, because the condition will practically always be recognised beforehand and the necessary dispositions therefore have been made. As regards the remaining cases it seems justified, also from the obstetric point of view, to maintain OVERGAARD's division of them into two groups (II and III). The

cases under group II are of little importance obstetrically, as most of them occur in elderly females after the age of menopause. Neither are the cases under group III of great importance obstetrically, since they only constitute a small percentage of all cases; but that there nevertheless among them may occur instances in which protrusion of the acetabulum in an apparently healthy and normal woman gives rise to complication at delivery is shown by the case described in this paper.

SUMMARY

The author describes a case of protrusion of the acetabulum, in a 32-year-old primipara, which resulted in prolongation of the parturition and delivery; and discusses the etiology of the disease.

ZUSAMMENFASSUNG

Verf. beschreibt einen Fall von vorstehendem Acetabulum bei einer 32jährigen Erstgebärenden, was zu einer Verzögerung der Entbindung führte, und bespricht die Ätiologie der Krankheit.

RÉSUMÉ

L'auteur décrit un cas de protrusion acétabulaire chez une primipare de 32 ans qui entraîna une prolongation du travail et de la délivrance; il discute de l'étiologie de l'affection.

LITERATURE

1. Bonnet, C. and Brehont: La presse médicale 1938—46—Nr. 100.
2. Brentrup, H.: Arch. f. orthop. u. Unfall-Chir. 1942—42—241 and 1944—43—154.
3. Burchardt (Cit. after Brentrup).
4. Doub: Radiologi 12—369—1928.
5. Eppinger (Cit. after Brentrup).
6. Féré [Cit. efter Pomeranz).
7. Gickler: Zschr. f. orthop. Chir. 66—1937 and 68—1938.
8. Gilmour: Brit. Journ. of surg. 26—670—1939.
9. Hale-White (Cit. after Brentrup).
10. Kienböck (Cit. after Overgaard).
11. Kooreman: Nederlands Tijdschrift v. Geneeskunde 1940—84—Nr. 29.
12. Kuliga (Cit. after Overgaard).
13. Løbel (Cit. after Gilmour).
14. Overgaard, K.: Acta Radiologica 16—390—1935.
15. Pomeranz: The Journ. of Bone and Joint surg. 14—Nr. 3—1932.
16. Ponfick (Cit. after Brentrup).
17. Saupe (Cit. after Brentrup).
18. Schaap: Zschr. f. orthop. Chir. 61—1934.
19. Schertlin (Cit. after Pomeranz).
20. Schlagenhaufer (Cit. after Overgaard).
21. Sinn: Røntgenpraxis 4—1932.
22. Valentin and Müller (Cit. after Overgaard).
23. Waller: Deutsche Zschr. f. Chir. 168—19—1922.
24. Zwicker (Cit. after Brentrup).

FROM THE DEPARTMENT OF ROENTGENDIAGNOSTICS, SAHLGRENSKA HOSPITAL, GOTHENBURG (CHIEF: DR. G. RUNSTRÖM)

THE ROENTGEN DIAGNOSIS OF FLUID IN THE FRONTAL AND SPHENOIDAL SINUSES[1]

by

Dag Turesson

The usual technique in Sweden for radiographing the paranasal sinuses consists of taking four projections (1) occipitofrontal with 25° cranial tilt of the central ray (2) half axial view with the mouth open and 20° cranial tilt of the central ray (3) full axial view with the head hanging and submento-vertical direction of the central ray and (4) straight lateral view.

CALDWELL and KILIAN were the pioneer workers in the roentgen diagnosis of sinus disease. They introduced the half axial projection of the maxillary sinuses and showed that a sinus filled with fluid gave rise to a shadow on the roentgen picture. The first important Swedish work on the roentgen appearances of the sinuses was CARLSTEN's paper in 1917.

The old fashioned apparatuses required long exposure times and the patient could only be kept still in the lying position. As apparatuses and roentgen tubes improved, exposure times became shorter and it was then possible to examine the patient either sitting or standing. Around 1930 many workers, notably MITTELMAYER, HODGSON, LANGENBECK and LYSHOLM demonstrated the value of the horizontal ray with the head in the upright position. With this technique it was possible to decide whether a density of the maxillary sinus was due to thickened mucosa or fluid exudate, for the later shows a fluid level on the roentgen picture when a horizontal ray is used. Since that time fluid levels have been universally recognized and HODGSON showed further that levels change their position if the head is tilted to the side. Also fluid levels in the frontal sinuses have been described by several authors, but fluid levels in the sphenoidal sinuses, as far as I am aware, have not been described before.

In routine nasal sinus examinations nowadays both Sinus 1 pro-

[1] Submitted for publication, Aug. 16, 1947.

jection and the half axial projection are taken with a horizontal ray and the patient sitting. On the other hand the lateral and full axial projections are taken with the patient lying and the ray vertical.

The demonstration of fluid levels in the maxillary sinuses usually provides no difficulties especially if stereoscopic pictures are taken. Fluid levels reveal themselves fairly clearly in the normally large and deep maxillary sinuses, and in difficult cases one obtains help from LANGENBECK's technique of inclining the head to the side.

In the frontal sinuses, on the other hand, conditions are different, largely on account of the great anatomical variations. All gradations are found from a complete aplasia of the frontal sinuses to complete pneumatisation of the supra-orbital portions of the frontal bones and orbital roofs. The picture is further complicated by numerous septa which divide up the frontal sinuses into more or less completely separate compartments and recesses. The depth of the frontal sinuses can vary from a few millimetres up to 1—2 centimetres. Finally the two frontal sinuses are often of different size and the septum between them may be very oblique.

In frontal sinuses of normal size the conditions for producing fluid levels are the same as for the maxillary antra. On the other hand difficulties arise with very shallow frontal sinuses, with sinuses with many compartments and with a very small fluid exudate. In cases with very shallow frontal sinuses sometimes a thin layer of fluid produces only a very slender shadow on the roentgenogram and sometimes, on account of capillary attraction the upper border of the fluid may have a concave outline instead of horizontal, and quite obvious levels will not be diagnosed.

In frontal sinuses divided up into many compartments the fluid may completely fill some compartments while in other of them small air bubbles may be present without revealing typical levels. Very small exudates can easily be hidden on the roentgen picture by irregularities in the floor of the frontal sinus, and thus escape notice.

To overcome these diagnostic difficulties RUNSTRÖM has elaborated the examination by taking pictures of the frontal sinuses with the patient's head in the lateral position, but otherwise the projection is the same as Sinus 1, so that the picture is exactly comparable with Sinus 1 with the head upright. If an exudate is present it will be displaced when the head is moved; and the fluid level will assume a position with the head on the side at right angles to that in the erect posture. A bubble of air lying in a recess over a collection of fluid will be displaced when the head is on the side. The air will be displaced to the highest part of the recess in the new position of the head (see Figs 1 & 2).

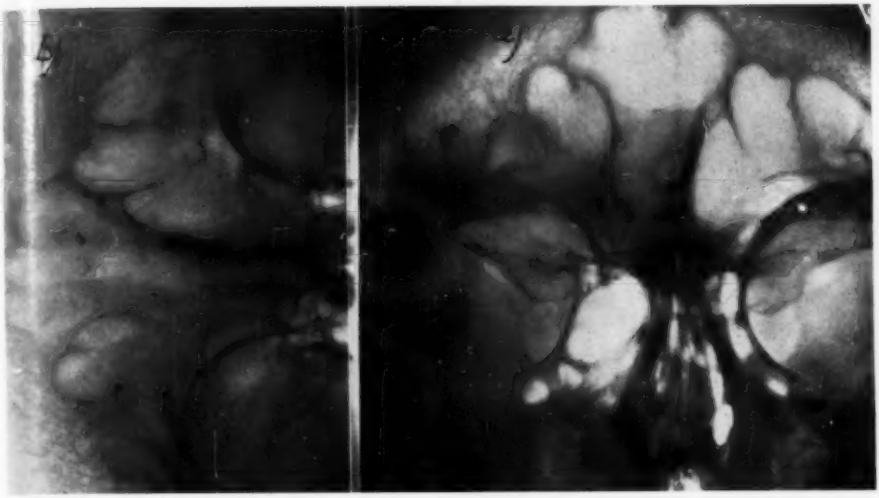


Fig. 1. Exudate in medial compartment of right frontal sinus.
a) Shape of fluid level in sitting position.
b) Shape of fluid level in lateral position.

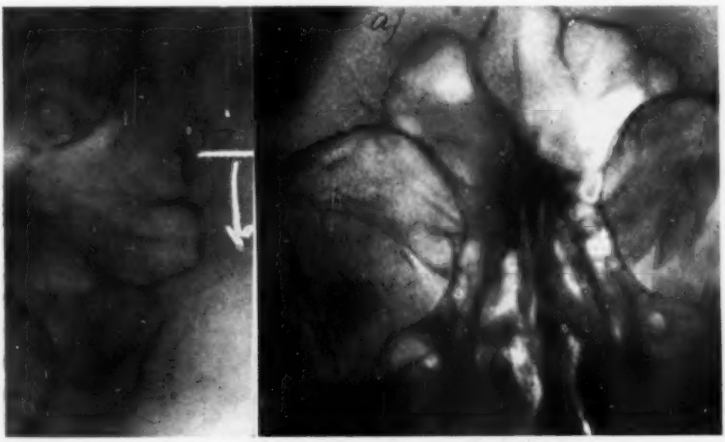


Fig. 2. Exudate in the right frontal sinus with a small bubble of air above.
a) Shape of level in sitting position
b) Shape of level in lateral position.

Fig. 3. Swelling of the mucous membrane in the floor of the left frontal sinus.
a) Sitting position. b) Head on the side.

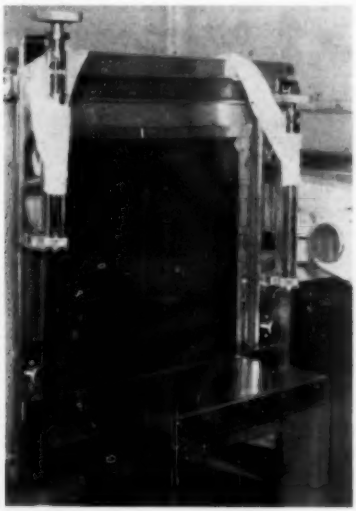


Fig. 4. Shelf mounted on the skull table.

On the other hand if a swelling of the mucous membrane is present naturally its position will not alter with a change in the position of the head. (Fig. 3.)

Fig. 5. Fig. 6.

Fig. 5. Position for lateral projection of sphenoid sinus with the patient sitting.
Fig. 6. Position for full axial projection with patient sitting.

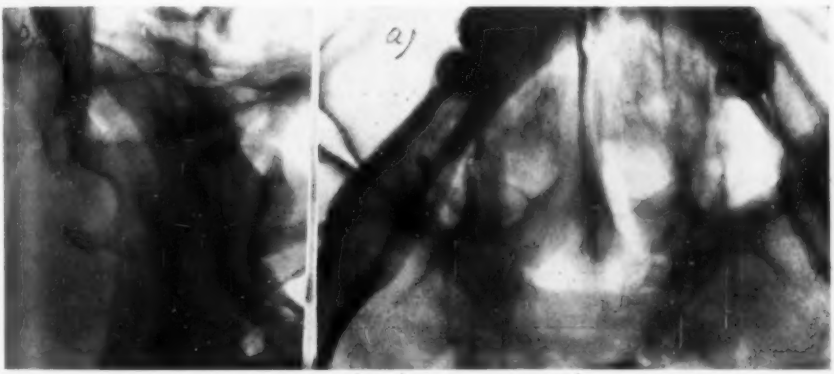


Fig. 7. Exudate in the sphenoidal sinus.
a) Fluid level in axial projection. b) Fluid level in lateral projection.

The usual technique for examination of the sphenoid sinuses, 1. full axial projection with the head hanging down and 2. lateral view with the head on the side, does not provide the opportunity of seeing fluid levels. In order to make this possible Runström devised a technique whereby both projections were made with a horizontal ray. The author has constructed a shelf which could be screwed on to the Lysholm table in the vertical position. (Fig. 4.) With the aid of such an arrangement both a full axial and lateral projection of the sphenoidal sinuses may be taken with a horizontal ray without difficulty, with the patient in the sitting position. (Figs. 5, 6 & 7.) This technique is

less unpleasant for the patient than the method used hitherto with the hanging head. By this means a feeling of dizziness and general discomfort is avoided.

This technique has enabled us to visualise fluid levels in the sphenoidal sinuses and in order to confirm the diagnosis we have completed the examination by taking a lateral projection in the prone position with a horizontal ray, thus showing the altered position of the fluid level.

SUMMARY

The author describes an improved technique for diagnosing fluid levels in the frontal and sphenoidal sinuses with the aid of a shelf attached to Lysholm's skull table.

ZUSAMMENFASSUNG

Verf. beschreibt eine verbesserte Technik zur Diagnose von Flüssigkeitsspiegeln im Frontal- und Sphenoidalsinus mit Hilfe eines an den Lysholm'schen Schädeltisch befestigten Horizontalbrettes.

RÉSUMÉ

L'auteur décrit un perfectionnement technique pour diagnostiquer les niveaux liquidiens dans les sinus frontaux et sphénoïdaux, à l'aide d'un rayon attaché à la table cranienne de Lysholm.

REFERENCES

Law, F. M., Am. Roentgn. vol. XV.
Carlsten, D. B., Röntgenologie der Nasennebenhöhlen 1917.
Mittermayer, Fortschr. Rtg. strahl. Erg. B. 45. 1931.
—, J. Laryngol. a. Otol. 46. 661. 1931.
Langenbeck, Z. Hals usw. Heilkunde 1932 s. 468.
Hodgson, H. K. G., J. Laryngol. a. Otol. 46. 729. 1931.
—, Brit. J. Radiol. 4. 421. 1931.
—, Brit. Med. J. 5—8. 3757. 1933.
Lysholm, E., Acta Radiol. suppl. XII. 1931.
—, App. f. Präzionsaufn. des Schädels 1935.
Runström, G., Acta Radiol. XVIII s. 119. 1937.
Turesson, D., Nord. Med. 25. 633. 1945.

THE USE OF A MOBILE SOURCE OF LIGHT IN RADIOGRAPHY[1]

by

Yrjö V. Paatero

Everyone who has radiographed human anterior teeth is well aware that not more than two or three teeth can be satisfactorily seen on one film. The outermost teeth are always obliquely projected, »stretched» in the horizontal direction, and often superimposed, in addition. This difficulty in radiographing the incisors is due to the shape of the dental arch, viz. the curve of its anterior part. Largely on account of this anterior part of the dental arch 10—16 films must be made to obtain a full mouth survey, dental films of the common size 3×4 cm. being used.

As this method of radiographing the upper and lower teeth requires much time and film material, I began to design a simpler method for full mouth examination. Continuing my studies I finally found a method, which appeared good at least in theory and seemed to be possible to realize.

As the accuracy of a full mouth survey is, in a manner, directly proportional to the number of the separate images, the best combined image would be obtained if the number of the separate images were indefinite. And it may be imagined that an indefinite number is attained by allowing a very narrow vertical cluster of rays to move slowly and equally along the set of teeth to be radiographed. If a demi-wave roentgen outfit is available — and most dental roentgen outfits are probably of this type — the maximum speed with which the cluster of rays moves is determined by the frequency of the alternate current; if the speed is too great a linear image will be obtained. Besides, the speed of the film and the intensity of radiation are of course factors to be considered when determining the speed of the movement. The cluster of rays should, when moving, always be perpendicular to the alveolar process. By this means a full mouth

[1] Submitted for publication, July 5, 1947.

Fig. 1. The use of the film in the tests in the lower jaw, diagrammatically presented. The intensifying screen (V), the film (F), the black paper (P) and the lead plate (L) have been closed into a casette of thin rubber.

survey is made in which every tooth, and even each detail of tooth, is orthoradially projected on the film. Thus, by the use of this method the usual thickening of the teeth is avoided, but, on the other hand, the teeth in the curved anterior part of the alveolar process appear slightly narrower than they actually are, as a result of the curve of the film being shorter than the corresponding alveolar arch. From the point of view of diagnosis a slight narrowing of this kind probably causes no disadvantage as a rule. The extent of the narrowing naturally depends on the shape of the jaw to be radiographed. The narrower the anterior part of the jaw, the greater is the narrowing of the teeth in the image.

As the new method is based on the equal motion of the roentgen focus and the patient in relation to each other during exposure, it remains to be decided, which of the two, the roentgen tube or the chair on which the patient is sitting, is to perform this motion. Without going deeper into the question it may appear simpler to construct a mobile roentgen tube which rotates around the patient's jaw and turns in a suitable manner. On closer consideration it is easily observed that construction of a mobile chair is, however, much easier. In addition, roentgen examinations may then be made by the new method with any roentgen equipment to which a slit director tube is fitted. The movement of the chair may of course be brought about in different ways. In the interest of economy a construction as simple as possible should be aimed at in order that the new method might become extensively used. As regards the question of motive power, the chairs could be worked either by hand or by motor, in which latter case the motor could be electrically connected with the roentgen outfit,

Fig. 2. A radiograph of the upper jaw, taken by proper motion.

in such a way that also the chair could be set in motion by pressing the button of the timeswitch. Such a syncronization of motion and exposure would perhaps be practical and easy to realize.

When carrying out my experiments I have not had a chair of this kind at my disposal, i. e. one moving linearly forward and backward as well as around its vertical axis. Therefore I have used only a rotatory motion and the images cannot consequently be nearly as good as when the patient's motion corresponds to the shape of the dental arch.

The row of teeth (alveolar arch) is generally straight from the wisdom tooth to the first premolar. Then follows a regular circle (c. 130 degrees), the centre of which is on the line of intersection of the medial plane and a vertical plane passing through the mesial surfaces of the first molars.

If an exposure is to be made by the slit method without the proper chair being available, fair results may be obtained in some cases, as shown by the attached radiographs (Fig. 3), by moving the chair only around the vertical axis, a suitable point on the line of intersection of the medial plane and a vertical plane passing through the second molars being chosen for the centre of the rotatory movement. The definitive location of the point is determined by the shape of the dental arch in each case.

In order to produce the cluster of rays required for the application of the new method I have made experiments with different director tubes. My latest director tube is telescopic so that by extending and

Fig. 3. A radiograph of the lower jaw, taken by rotary motion.

shortening it the focus-slit distance required in each case can be obtained. The tube may be of ebonite or some other insulating substance. Its interior surface is lined throughout with lead plate for the purpose of preventing the escape of roentgen rays from the tube. The outer end of the director tube is also fitted with a lead plate which has a narrow vertical slit, through which a narrow fanlike cluster of rays may issue. The width of the slit should be adjustable. The fact is namely that, when an object is radiographed on a straight film, the slit can be broader than if a curved film is used, as is the case for instance when exposures of the anterior teeth are made. On the basis of my experience to date, a slit, 0.5 to 1.0 mm. in width, must be used for the anterior teeth, whereas a good result is obtained in the molar area even with a slightly broader slit. When a whole set of teeth is radiographed it is of course necessary, for practical reasons, to use a slit which is suitable both for the anterior teeth and the molars.

It is of course advisable to try to keep the slit-film distance as small as possible during the exposures in order to obtain an image with sharp outlines in all details.

As regards the size of the vertical direction angle of the central beam, the rules which are used at present may be followed in the main. This angle must generally be bigger when incisor teeth are radiographed than in the case of molar teeth and attention must be paid to this requirement also in the new method. This may be realized in practice by bending the patient's head slightly forward for the upper jaw examination and, on the contrary, slightly backward when the lower teeth are radiographed. When the beam director is in addition

adjusted so as to form a definitive angle with the horizontal plane, the correct vertical direction of the central beam is obtained, on an average.

As the films required for the slit method are not yet available, strips of suitable shape and size have been cut from ordinary big films. Films of different shape are needed for the upper and for the lower teeth. As even the most rapid films available are not as such rapid enough, an intensifying screen has been used to increase the rapidity. Fig. 1 shows diagrammatically the use of the film in the tests. The intensifying screen (V), the film (F), the black paper (P) and the lead plate (L) have been closed into a casette of thin rubber. When thus used, this kind of film is adequately exposed during 8 seconds, and an image of the whole set of teeth is obtained by turning the chair only once.

For the purpose of keeping the film in position I have constructed a metal holder, the shape of which corresponds with that of the normal dental arch of man. This holder is placed in the mouth behind the teeth in such a way that the film will be between the holder and the set of teeth; thus the holder presses the film from the inside against the alveolar process and teeth along the whole length of the dental arch. On both sides in the area of the molars the holder has a small horizontal rubber-covered appendage. When the patient now closes the jaws these appendages remain between the upper and the lower teeth and the film remains firmly in position during the exposure. The holder is made of thin metal plate and it may thus be bent by hand so as to suit each mouth.

Application of the slit method in general radiography

Although my slit method was originally designed to simplify dental radiographic examinations, it is of course also suitable for roentgen examinations of other objects. By the use of this method an isometric image of an object is obtained in the direction of the motion, but in the longitudinal direction of the slit the usual phenomenon occurs that the image is larger than the radiographed object. This enlargement of the image is due to some well known factors.

Experiments have shown that, by the slit method, very accurate images are obtained on ordinary straight films and in that case the distance between the various points on the object in the direction of the movement may be measured direct from the radiograph; in the longitudinal direction of the slit the required corrections must be made, however.

As now the enlargement of the image in one direction is eliminated, thanks to the slit method, the thought occurred to me whether it might be possible to eliminate enlargement also in the other direction.

It can be made at least in theory by replacing a point-like focus by a linear focus, the length and direction of which equals those of the slit (Fig. 4). In this linear focus every point of course acts as a point focus issuing roentgen rays into different directions. Oblique

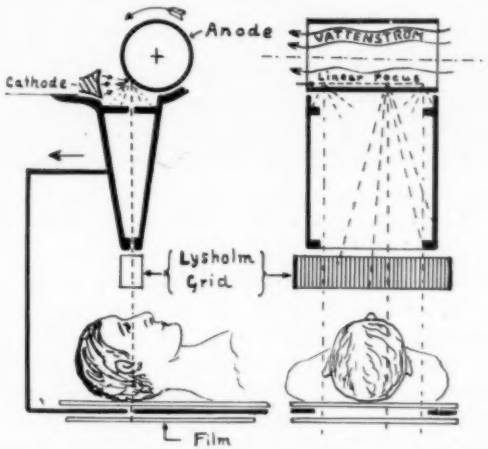


Fig. 4. Schematic diagram of a roentgen apparatus provided with a linear focus.

radiation should thus necessarily be eliminated by allowing only those beams to issue through the slit which meet the film perpendicularly. This elimination of oblique radiation would perhaps take place most practically by means of a mobile grid (Lysholm) which, in my opinion, should be close to the slit of the director tube in order to prevent oblique radiation from reaching as far as the object to be radiographed. Motion of the grid would naturally be in the longitudinal direction of the slit.

In order that an effective cooling would be brought about, the anode could for instance be a rotating hollow cylinder of metal, through which the water would run.

After having developed my linear focus theory, reported above, on account of the good results I had achieved in the radiography of teeth, I noticed that Mr. Robert H. Millwee (Radiology 1937, vol. 28 n:o 4) had constructed a roentgen apparatus, the tube of which moves horizontally above the patient's table. If a roentgen apparatus like this was provided with a linear focus anode and a Lysholm grid in

the way I mentioned, quite isometric radiographs could be taken. By means of two images taken in this way, perpendicularly to each other, the place of some extraneous object in the tissue could exactly be traced.

SUMMARY

On account of the positive experiences acquired by the author in the use of a mobile source of light for the radiography of teeth, he has thought of applying the same method to all medical radiography in the following way: out of a roentgen tube moving parallelly to the plane of the film and fitted with a linear focus, a cluster of rays is sent out of a narrow lead slit through the object in the direction of the film. The oblique primary rays are eliminated by a Lysholm-grid moving between the ray directing tube and the object. By proceeding in this way fully isometric roentgen pictures could be obtained.

ZUSAMMENFASSUNG

Wegen der positiven Erfahrungen, die der Verfasser von der Anwendung einer beweglichen Lichtquelle bei der Röntgenphotographie der Zähne erworben hat, hat er sich die Anwendung derselben Methode bei jeder medizinischen Röntgenphotographie auf folgende Weise vorgestellt. Aus einer Röntgenröhre, die sich mit dem Plan des Films parallel bewegt und mit einem Linearfokus ausgestattet ist, sendet man, nach dem Film gerichtet, durch eine enge Bleispalte ein Strahlbüchsel quer durch das Objekt. Ein Lysholm-Gitter, das sich zwischen der Richtungsröhre der Strahlen und dem Objekt bewegt, eliminiert die schiefen Primärstrahlen. Durch diese Methode könnte man vollkommen isometrische Röntgenbilder erhalten.

RÉSUMÉ

Se basant sur les expériences personnelles positives de l'emploi d'une source de lumière mobile dans la radiographie des dents, l'auteur propose l'application du même procédé à toute radiographie médicale de la manière suivante. D'un tube Roentgen, se mouvant parallèlement au plan de la pellicule et muni d'un foyer linéaire, on fait diriger vers la pellicule, par une fente de plomb étroite, un faisceau de rayons à travers l'objet. Un grillage de Lysholm, se mouvant entre le tube directif des rayons et l'objet, supprime les rayons primaires obliques. Par ce procédé on pourrait obtenir des radiographies complètement isométriques.

FROM VESTFOLD FYLKESSYKEHUS, DEPARTMENT OF ROENTGENOLOGY, TØNSBERG, NORWAY (HEAD: K. E. SCHREINER, M. D.)

MICROCOLON[1]

With report of two cases

by

Johannes Zimmer, M. D.

The congenitally small colon or microcolon (m) designates a condition in which the entire large bowel (except the rectum) of a newborn infant anatomically is found to have a diameter of around 4 to 8 millimeters (the size of a »leadpencil», »colon en miniature»).

Beside this the following features are noted:

a. Hypertrophy and dilatation of a longer or shorter segment of the small intestine, usually in the ileum (3—5 centimeters in diameter).

b. A sudden or more gradual change of calibre in the small intestine distal to the dilated segment, with narrowed lumen containing inspissated meconium.

c. No demonstrable stenosis or atresia of the gastro-intestinal tract.

This is called the *primary type* of m. since no anatomical obstruction of the gastro-intestinal tract is seen, attributable to the development of a m. (see »etiology»).

d. If, however, a congenital obstruction proximal to the sigmoid colon is present, a m. infrequently has been disclosed at operation or at the post mortem. Depending upon the site of the obstruction, if proximal to or in the colon, the entire large intestine or part of it is reduced in size.

This is named the *secondary type* of m. since the obstruction is held causative for the underdevelopment of the colon.

Etiology and Pathogenesis

Primary type: 1. Developmental factors, 2. primary dilatation and hypertrophy of the small intestine, 3. primary hypoplasia of the colon, 4. temporary incarceration of a segment of the small intestine, 5.

[1] Submitted for publication, June 18, 1947.

changes in the innervation of the bowels, and 6. mecanical factors are offered by different authors (Scenes, Scroeder, Drost and others) to explain this type of m.

This is not the place for a detailed discussion of these theories. What we know for sure is that hard, inspissated meconium, not stained with bile, always is present. Further, the study of embryology shows us that meconium fills the small intestine from the 4th fetal month, as the secretion of bile starts. The width of the lumen of the small intestine gradually increases as does the thickness of the intestinal wall. The colon normally is empty and not wider than the small intestine up to the 7th fetal month. From then on the colon fills with meconium and gradually exceeds the width of the small intestine.

From these facts it seems logical to explain the primary type as the result of a »never used» colon, empty and atropic, due to inspissation of meconium early in the fetal life. *Why* the meconium becomes inspissated remains open to answer. Most likely reduced or impaired secretion from the liver, the pancreas or both is the correct explanation (Schroeder).

Secondary type: In cases showing organic obstruction the m. definitely is secondary to this because of lack of content (disuse). Concerning the various theories offered to explain how a congenital stenosis or atresia occur I refer to Hunt's paper.

Frequency

A review of the literature reveals the m. to be a rather infrequently published condition.

In Scandinavia Dahl-Iversen found one case of the primary type in 36 cases of ileus due to congenital malformations in newborn infants (1922). Schroeder collected one similar case among around 85,000 births, and reviewed 17 identical cases from the literature (1937).

Hunt suggests two cases of congenital stenosis or atresia of the gastro-intestinal tract among 4,000 hospital births. Greig (according to Hunt) and Clogg both found 5 % of these obstructions in the colon, the majority being in the small intestine and esophagus. The literature does not give any figures as to the frequency of the secondary m.; Hunt feels that this condition is not as rare as the impression given by the literature. He published 4 cases of this type, seen within a short period of time.

Familial occurrence of the primary type is reported as well as m. combined with other developmental defects (Stephenson *and others*).

Pathology

Colon: In both types the microscopy reveals a perfectly built normal bowel, consisting of all layers, the only noticeable change from the

normal colon being the small lumen, containing some mucus, rarely meconium in small quantities, the latter being inspissated if present. The rectum always shows normal width. If an obstruction is present (sec. type) the lumen shows dilatation oral to this.

Small intestine. A. *Primary type:* Muscular hypertrophy of the dilated segment, the lumen filled with greenish, puttylike meconium. Collapsed, somewhat underdeveloped bowel distal to this segment, containing hard lumps of dehydrated meconium, not stained with bile, down to the narrow but else normally developed ileo-cecal valve.

B. *Secondary type:* Hypertrophy and dilatation proximal to, collapse distal to the obstruction. The entire small intestine is dilated if the obstruction is located in the colon.

Stomach: often considerably dilated.

The obstruction may be of *intrinsic* nature (congenital stenosis or atresia) or caused by *extrinsic* pressure (faulty rotation of the intestines, peritoneal bands).

Clinical manifestations

Primary type: A scrutiny of the literature shows the infants to be fullborn, they appear healthy at birth and nurse normally until vomiting starts, usually between 12 to 24 hours after birth. No meconium is passed by rectum, which is of great importance to notice. The anus is perforate, the rectum feels normal, the palpating finger stops abruptly at the junction to the sigmoid colon.

The vomiting recurs with increasing frequency, the vomitus usually being stained with bile, showing a greenish-black fluid. The baby refuses to nurse. The abdomen gradually distends with dilated superficial veins, sometimes visible peristalsis is seen. If surgery is not performed the child becomes dehydrated, loses weight and death follows.

Secondary type: If an atresia is present the vomiting often starts early, up to a few hours after birth. The rule is that the lower in the gastro-intestinal tract the obstruction is located and the more incomplete it is, the later the symptoms start and the more distended the abdomen appears. Bile-stained vomitus is indicative of an obstruction distal to the papilla of Vater, and reguration indicates an esophageal obstruction.

Case reports

Case 1. Forty-eight-hour old fullborn baby girl, admitted to the Vestfold Fylkessykehus under the diagnosis: ileus, atresia?

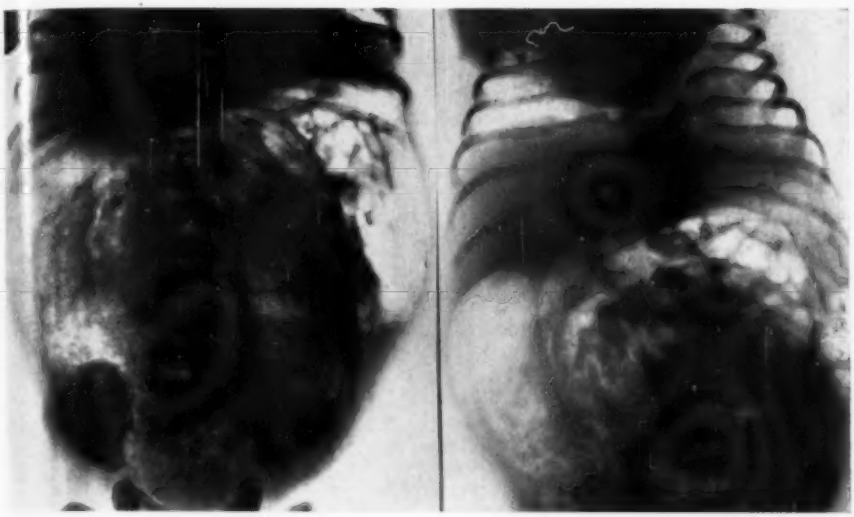


Fig. 1. Fig. 2.

The baby appeared healthy at birth, but started to vomit a greenish-black material, a few hours after birth, refused to nurse and showed gradual distention of the abdomen. *No meconium was passed since birth.*

On admission the baby showed all signs of ileus, with dilated abdominal veins and visible peristalsis beside the above mentioned symptoms. No palpable tumor in the abdomen, no blood observed passed from the anus. Rectal examination revealed a normal anus and rectum; the finger stopped abruptly at junction to the sigmoid loop, feeling the lumen narrowing at this point. Slight bleeding followed. The infant's general condition looked good, no dehydration. *Roentgenographic study of the abdomen:*

Vertical beam: Gross, extensive dilatation of intestinal loops to a diameter of about 4 cm. The longitudinal axis of the loops ran almost parallel to the midline axis of the body. No »feathery, herringbone-like» pattern, indicating distended small bowel loops. Some normally looking, displaced small bowel loops, containing air, were seen to the left of the midline. No dilatation of the stomach (Fig. 1).

Horisontal beam: No fluid levels observed in the dilated air-filled loops, which seemed to contain hard, granulated fecal matter. (*Fig. 2*).

Since the roentgenograms in some way were indicative of a volvulus of the sigmoid colon and the symptoms had lasted for more than 24 hours no barium enema was administered because of the possible risk of rupturing the bowel.

Operation revealed marked distention of the proximal part of the ileum and lower part of the jejunum to a diameter of 4—5 cm., *containing no fluid at all.* The ileum distal to the dilated segment showed generalized collapse, the diameter of the bowel gradually decreasing down to around 5—7 mm. near the ileo-cecal junction. *Hard lumps of meconium* were felt in this region. The colon showed contraction to a small cord, about the size of a *leadpencil.* Its length was normal. No organic obstruction could be detected.

Fig. 3.

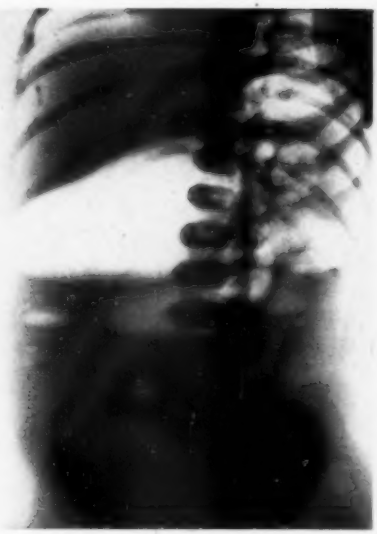


Fig. 4.

Fig. 3. — *Case 2* (sec. type): Supine position, vertical beam. Air-distended loops of small intestine; no inspissated fecal matter. Lower abdomen empty. — Prestenotic loop = x.

Fig. 4. — *Case 2.* (sec. type): Erect position, horisontal beam. Fluid levels in the distended loops. Ileus. (mecanical).

Part of the dilated loops was resected. The lumen contained putty-like, greenish-black meconium. The baby's condition did not improve, death followed 48 hours after operation.

Autopsy revealed a typical microcolon, the diameter of the lumen measuring 5—6 mm down to the rectum, which appeared normal in width. Some mucus, no meconium in the lumen. The collapsed part of the ileum showed inspissated meconium, not being stained with bile. The ileo-cecal valve small, normally built. Microscopy showed normal conditions but for a slight superficial infection of the colonic mucosa.

Case 2: Sixty-hour old baby girl, appearing healthy at birth, nursing normally until 17 hours after birth, when vomiting of bile-stained greenish-black fluid started. *No meconium passed from rectum.* Anus perforate. Gradual, progressive distention of the abdomen.

Roentgenographic study showed gross distention of the small intestine in the upper part of the abdomen. One enormously dilated loop was extending also to the right of the midline (the prestenotic loop). Lower abdomen empty. (*Fig. 3*). With horisontal rays *fluid levels* were seen in the intestinal loops, which *did not contain any inspissated fecal material* (*Fig. 4*).

Fig. 5.

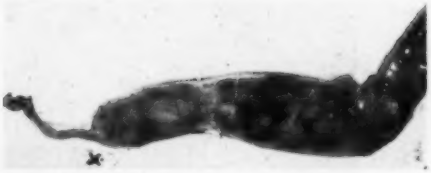


Fig. 6.

Fig. 5. — *Case 2.* Barium enema. Typical microcolon.

Fig. 6. — *Case 2.* Anatomical specimen. Lower ileum. Point of atresia = x.

Since the roentgenological diagnosis was ileus, probably due to an atresia in the ileum, a barium enema was administered to see whether the atresia was combined with a microcolon or not. A *typical microcolon* was found to be present (*Fig. 5*).

Operation revealed a complete atresia in the lower ileum with collapsed, atrophic small intestine and the entire colon but for the rectum. This micro-intestinal condition started distal to the atresia, while gross distention was seen proximal to this point.

An anastomosis was performed between the ileum and the transverse colon. The segment showing atresia was resected (*Fig. 6*).

The baby's general condition became poor during operation and death occurred 5 hours later. No autopsy.

Comments

Though the roentgenological examination in case one (primary type) showed a somewhat similar appearance as seen in volvulus of the sigmoid colon the diagnosis of »meconium ileus» was suspected because of absence of meconium after birth. An intussusception or a Meckels diverticulum were excluded because of no extensive amount of blood passed by rectum.

The following two roentgenological features are to be stressed:

1. *No fluid levels* in the intestinal tract by use of a horisontally projected beam. Absence of this sign must be due to the inspissated content in the bowel and is probably *pathognomonic* of *»meconium ileus»*. This is nowhere found mentioned in the literature.

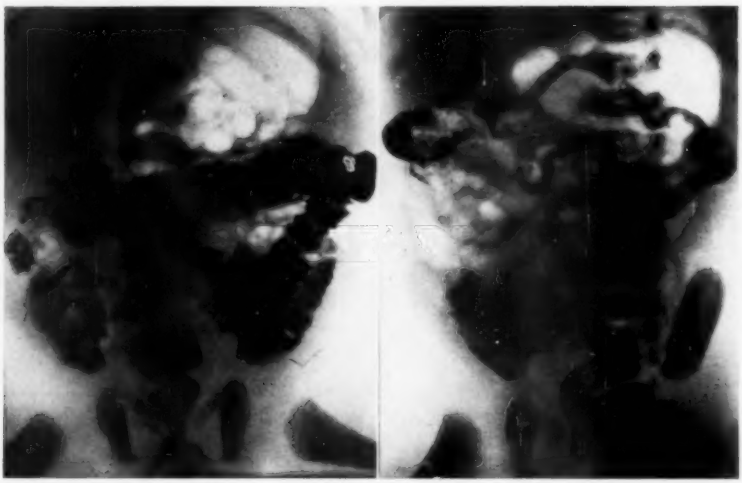


Fig. 7. Fig. 8.

Fig. 7. — Normally developed colon in a four-day old fullborn baby girl (own investigation).
Fig. 8. — *Case 1.* Microcolon. Post mortem examination.

2. *The absence of taut plicae circulares* in the small intestine, making it almost impossible to distinguish between this bowel and the colon, complicating arriving at a correct diagnosis before operation. For the same reason it is difficult to distinguish between jejunum and ileum.

In cases showing organic obstruction two points should be noted:

1. Fluid levels are often present (HUNT), as in the above reported case 2.

2. Hard, granulated fecal matter is not seen on the roentgenograms. These two points separate the secondary type from the primary, *roentgenographically.*

If an atresia is present no air is seen distal to this. If the roentgenographic findings suggest an obstruction it is often impossible to establish whether extrinsic or intrinsic. HUNT was is two cases able to observe a »pressure defect» of an extrinsic band across the barium-filled pyloric antrum.

A barium enema is reported carried out by various authors before operation, if the baby's general condition seemed good. It frequently appears to be a helpful aid in establishing the patency of the colon, the

width of the lumen and the length of the bowel, as in case 2. (The newborn infant's colon normally takes from 60 to 75 cc. of barium — Henderson & Briant.) The normal average width of the colon measured on the roentgen film is 15 to 20 mm., using a focus — film distance of 70 cm. *(Fig. 7)*, compared to 4 to 8 mm. for the microcolon *(Fig. 5 and 8)*. A. m. does not show any haustration like the normal colon in a newborn does. *(Fig. 5—7—8)*.

A barium meal is considered contraindicated in ruling out the diagnosis because of the danger of further obstruction due to lodgment of barium in a stenotic zone. (Hunt.)

Treatment

Concerning the treatment of the primary type the literature always shows fatal result after performance of an ileostomy. A few surgeons have performed a primary anastomosis between the lower end of the small bowel and the distal part of the colon. No primary case of m. has as yet been reported with survival, maybe because the babies have been operated upon rather late in the course of the disease. Early surgical intervention and *entero-anastomosis* are held imperative for a good result.

Cases of the secondary type of m. show a better chance of survival after entero-anastomosis, the prognosis being better the more proximal in the intestinal tract the obstruction is located. In cases showing survival the m. gradually was transformed into a normal-sized colon with use.

Conclusions

The *primary* type of microcolon (meconium ileus),

A. May be *suspected* if the following symptoms are present:
   1. No meconium passed by rectum after birth.
   2. Vomiting starts shortly after birth, being unrelated to meals, and the vomitus being bile-stained.
   3. No palpable atresia of the anus.

B. May be considered *definite* if the roentgenographic findings show:
   5. No fluid levels in the distended loops of the bowel.
   6. The distended loops containing coarse, granulated fecal matter (inspissated meconium).

In cases of atresia or stenosis *(secondary type* of microcolon) fluid levels may be seen roentgenologically. Granulated fecal matter is not seen.

A barium enema is a helpful and recommendable aid in establishing the diagnosis.

Orally administered barium is probably contraindicated.

SUMMARY

The term »Microcolon» designates a congenitally small but otherwise normally developed colon. Ileus always develops in newborn infants with a microcolon. The roentgenological aspects of microcolon are of considerable importance in ruling out a *definite* or *fairly definite* diagnosis prior to surgical intervention (*entero-anastomosis*).

ZUSAMMENFASSUNG

Der Ausdruck »Microcolon» bezeichnet ein von Geburt an kleines, aber sonst normal gebautes Colon. Ileus entwickelt sich immer bei neugeborenen Kindern mit einem Microcolon. Die röntgenologischen Kennzeichen des Microcolons sind von beträchtlicher Bedeutung, indem sie eine sichere oder beinahe sichere Diagnose vor dem chirurgischen Eingriff (entero-anastomosis) stellen.

RÉSUMÉ

L'expression »microcolon» désigne un colon dès l'origine petit, mais autrement normalement formé. L'ileus se développera toujours chez les enfants nouveaux-nés avec un microcolon.

Les aspects roentgenologiques de microcolon sont de grande importance pouvant permettre une diagnose définite ou presque avant l'intervention chirurgicale (entero-anastomosis).

REFERENCES

1. Bouslag, J. S.: The Normal Stomach and Small Intestines in the Infant. Radiology 39: 253/59: 1942.
2. Clogg, H. S.: Congenital Intestinal Atresia. Lancet 2: 1770/74: 1904.
3. Drost, E.: Beitrag zum Microcolon congenitum. Deutsch Zeitsch. f. Chirurgie 232: 764/67: 1931.
4. Ewing, J. B. & Cooke, W. E.: Two cases of congenital microcolon. Brit. J. of Surg. 25: 506/10: 1938.
5. Henderson, S. G. & Briant, W. W.: Colon in Healthy Newborn Infant. Radiology 39: 261/72: 1942.
6. Hughes, E. E.: Acute Intestinal Obstruction due to Inspissated Meconium. Brit. J. Child. Diseases. 19: 32/33: 1922.
7. Hunt, H. B.: Roentgenological Aspects of the Congenitally Small Colon. Am. J. Roentgenol. & Rad. Th. 41: 564/74: 1939.
8. Ladd, W. E.: Congenital Obstruction of the Small Intestine. J. A. M. A. 101: 1453/58: 1933.
9. Muhl, G.: Opererat fall av duodenalstenos hos nyfødd. Nord. Med. 27: 1947/48: 1945.
10. Rankin, Bargen, Buie: The Colon, Rectum & Anus. page 68: 1932.
11. Schroeder, E.: Om microcolon congenitum. Hospitalstidende 80: 897/918: 1937.
12. Stephenson, N. J.: Microcolon, two case reports. Radiology 27: 494/97: 1936.
13. Szenes, A.: Microcolon congenitum. Archiv f. Klin. Chirurgie 160: 486/98: 1930.

FROM THE ROENTGEN DEPARTMENT OF ULLEVÅL HOSPITAL, OSLO, NORWAY
(CHIEF: J. FRIMANN-DAHL, M. D.)

ROENTGEN EXAMINATION IN ACUTE DILATATION OF THE STOMACH[1]

by

J. Frimann-Dahl, M. D.

The condition of acute dilatation of the stomach is best known to the surgeons. Mostly it occurs in the postoperative period, but in a number of cases also, partly as a primary gastric and duodenal condition, partly purely symptomatically.

In spite of the variations in the symptoms with degree of the distention, the clinical diagnosis of acute dilatation of the stomach is comparatively simple. The patient is more or less exhausted, and the character of the vomiting or regurgitation varies. The shape of the enlarged stomach is felt on the outside of the abdominal wall by its peristaltic activity, or is determinable by percussion and auscultation. The evacuation of large quantities of stomach contents, in form of gas and liquid, on insertion of a stomach tube strongly supports the diagnosis. The situation may prove different, however, when the patient arrives with acute abdominal pain, possibly under suspicion of ileus or perforated ulcer. Rigidity of the abdominal wall or lowered peristaltic activity masks the true condition, suggesting e. g. a volvulus.

Only in the presence of gross enlargement of the stomach and abnormal quantities of gastric contents will the diagnosis of gastric dilatation come into question. Whereas the amount of gaseous contents can only be roughly estimated, is the liquid part directly measurable after aspiration. The liquid contents of a dilated stomach is generally 1–5 L.

Since the introduction and the steadily increasing use of roentgen examination as diagnostic means in acute abdominal conditons, the

[1] Read before the Congress of the Northern Association of Medical Radiology at Helsingfors, June 12, 1947; submitted for publication, July 3, 1947.

16—480088. *Acta Radiologica. Vol. XXIX.*

roentgenologist must learn to recognise the condition, the findings in which are capable of several interpretations. Systematic roentgen examination of all acute abdominal conditions will inevitably disclose many such cases, and a thorough knowledge of its various aspects is necessary for a confident diagnosis. Earlier roentgenologic reports concerning this subject are scarce, and consist mostly of single descriptions. The picture of a severe gastric dilatation is generally known, but less known is the variability of the findings, and the vital importance of the roentgen diagnosis in certain cases.

Acute gastrectasis is independent of the age of the patient, but it is mostly seen in elderly people, in whom specially gastric ulcer or cancer is found responsible for the stenosis. For limitation of the subject has discussion of dilatation in children (pyloric stenosis) been left out of this review. The object of the essay essentially being the discussion of the roentgenologic findings in acute abdominal conditions, also other special forms have been omitted.

The acute gastrectases may be divided into the following groups:

I. Dislocation and anomalies ..
1. Volvulus.
2. Diaphragmatic hernia.
3. Arterio-mesenteric obstruction (descensus).

II. Primary organic stenosis ...
1. Cancer of the pyloric region.
2. Ulcer of the pyloric region.
3. Cicatricial pyloric changes.
4. Inflammations of the pyloric region.

III. Secondary stenosis .....
1. Dislocations, enlargement of adjacent organs.
2. Extra gastric inflammations.
3. Tumors.

IV. Functional stenosis .....
1. Circulatory disturbances.
2. Pareses (postoperative).
3. Increase of gastric contents (aerophagy).
4. Disturbances in the gaseous exchange.

Gastric dilatation is, according to the above grouping, capable of primary occurrence, as an independent disease, or secondarily, in which case it must be regarded as purely symptomatical.

The author's material

For illustration of the various roentgen findings, a total of 20 cases have been collected from the 4 last years (3 cases from the Red Cross Clinic of Oslo), which goes to show that at a fair-sized roentgen institute the condition is not a rare one. Besides having been vitally important to the treatment of the patients, has the diagnosis in many cases offered considerable difficulties. Some of the most characteristic cases are recorded in the following.

Dislocations and anomalies

This group includes 1 case of gastric volvulus, 2 cases of diaphragmatic hernia and 1 of arterio-mesenteric obstruction.

Case 1. A female of 27 years, admitted on $^{18}/_{9}$ 46 for acute pain in left lumbar region, had earlier had recurrent attacks of violent pain below left costal arch, accompanied by vomiting. She had a feeling that all gastric activity had ceased, and she repeatedly vomited undigested food. The pain radiated to left shoulder and arm. The clinical diagnosis was uncertain, and the possibility of a left-sided renal stone was ventilated. *Urography* gave negative result. Examination revealed a high left diaphragm and an extensive fluid level below left costal arch. After the administration of contrast by mouth (Fig. 1 A—B) the fluid level was localised to the stomach, that was highly deformed and situated very high under the dome of the diaphragm. Tipped over and torsioned cardia was seen way down, the cavity part turning up towards the diaphragm. *The roentgen diagnosis* was *volvulus of the stomach.* A stomach tube relieved the organ of abundant amounts of gas and liquid, whereupon the stomach resumed its normal shape and size. The pain ceased and the patient felt comfortable. Later usual resection of the stomach was made to prevent recidivation. The postoperative course was uncomplicated.

The mechanism in the present case has probably been primary relaxation of the diaphragm. Position of the left dome of the diaphragm was, as mentioned, found 2—3 finger-widths above normal, which probably has been the primary cause of the torsion of the stomach around its mesenteric axis.

Many earlier roentgenologic reports of torsion of the stomach have been published (Feldmann, Mondor). This case, however, represents that of a patient arriving with acute abdominal symptoms, and admitted for routine physical examination. Torsion of the stomach leading to formation of a long fluid level, and *stratification* of the liquid gastric contents, when mixing with the contrast, are particularly noted. Treatment with stomach tube finished the symptoms, and the stomach returned into its normal position.

Torsion or volvulus of the stomach may also occur where dislocation already is present, e. g. in diaphragmatic hernia. The obstruction may

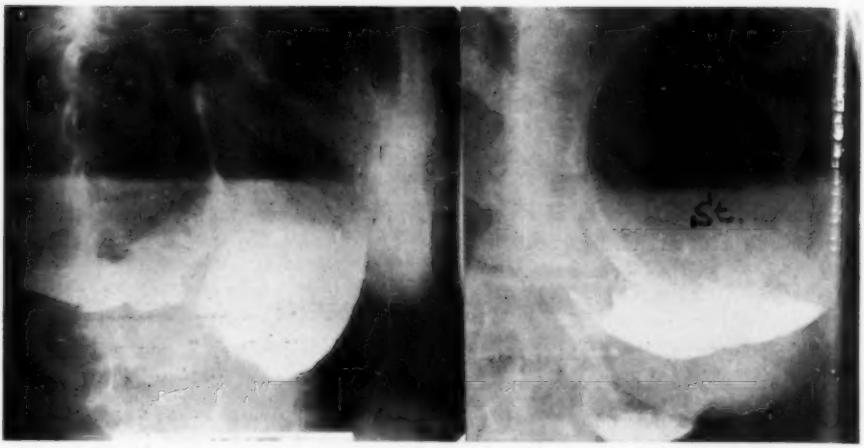


Fig. 1 A. Fig. 1 B.

Fig. 1. Volvulus of the stomach.
A. Side view. B. Frontal view after some Barium by mouth.

be due to incarceration, and the dilatation take place either in thorax or in the abdomen.

Case 2. (From the Red Cross Clinic of Oslo.)

A man, 50 years old, was admitted for violent pain under right costal arch. He was moaning loudly and vomited constantly. Clinically a perforated ulcer was suspected.

Roentgen examination revealed dislocation of most of the stomach to thorax, and in a standing position fluid levels were distinguishable in the cascade-shaped, highly distended stomach (Fig. 2 A). When lying on his back (Fig. 2 B) torsion with twisting of the cardiac part was seen to cause dilatation of whole of the stomach. On treatment with stomach tube large amounts of gas and liquid were evacuated and the symptoms vanished. The patient was later operated upon by Dr. ASBJÖRN NILSSEN who discovered a wide aperture in the diaphragm (probably of traumatic origin), through which large parts of colon and stomach were dislocated. Reposition of the organs and closure of the aperture. Postoperative course uncomplicated. The patient recovered from his trouble. In a case like this the diagnosis without the aid of roentgen is practically impossible. The picture discloses the position and the degree of rotation of the stomach in thorax. The diagnosis dictates an adequate treatment, and the patient is promptly relieved of his pains.

Duodenal ulcerations and tumours of various kinds may occasionally cause gastrectasis. A special form, often acute, known as *gastro-mesenteric ileus,* from duodenal occlusion, is due to the mesenteric vessels riding across the duodenum ascendens anterior (PALMER). Pre- or postoperative incidences are seen, mostly in connection with general ptosis of the organs.

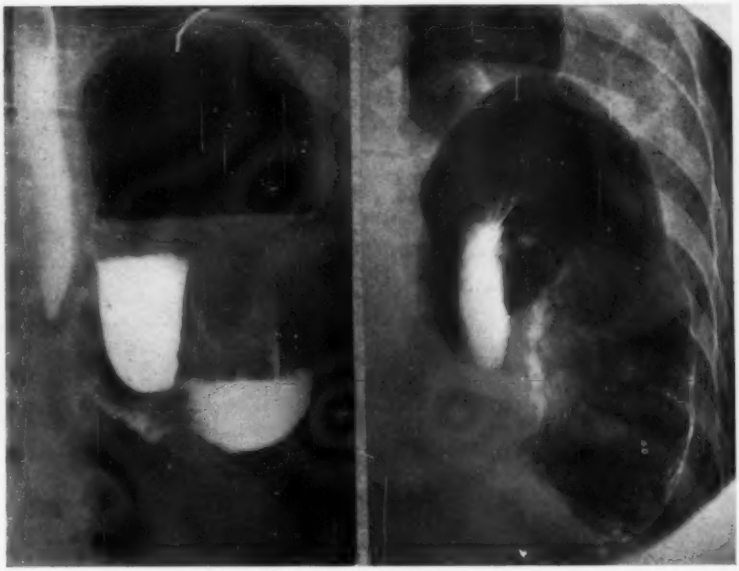


Fig. 2 A. Fig. 2 B.

Fig. 2. Volvulus of an intrathoracic stomach.
A. Upright. B. Supine.

Case 3. A man, 20 years old, had for some time been troubled by periodic vomiting unattended by marked pain. He had slight dyspnea because of a vitium cordis. Alkalosis and slight uremia were found, and up to 800 cc of gastric contents were aspirated. Lying prone in bed gave the patient some short relief, but vomiting soon started up again.

Roentgen examination revealed severe dilatation of the stomach with retention for 12 hours. The stomach was seen way down in the small pelvis, pushing the transverse colon before it. (Fig. 3 A.) Local picture of duodenum (Fig. 3 B) showed considerable stenosis of the inferior part, and characteristic transverse section of lumen.

Operation revealed an arterio-mesenteric occlusion of duodenum, corresponding to plica duodeno-jejunalis. Gastroenterostomy. Closure of the wound. Postoperative course uncomplicated.

The condition was in this case practically subchronic. The observed pronounced descendens of the organs is generally supposed to condition arterio-mesenteric occlusion. Local view of the duodenal part is further seen capable of giving the correct diagnosis before the surgical operation.

The next group is made up from cases of organic stenosis of the stomach, particularly of the pyloric region, and also of duodenal stenosis. This latter condition very rarely leads to gross dilatation of

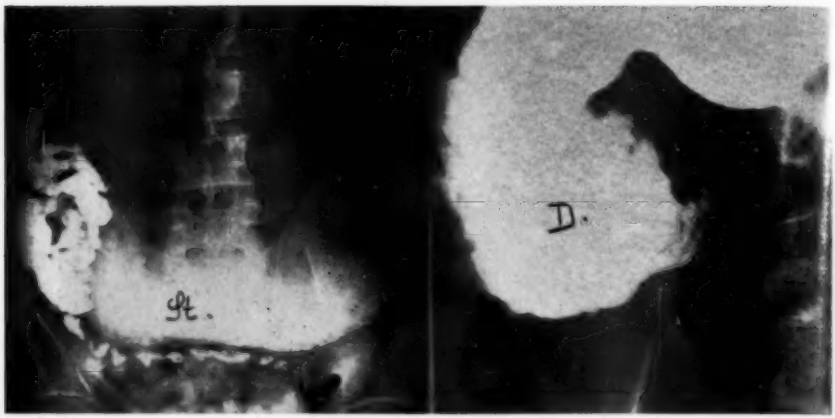


Fig. 3 A. Fig. 3 A.

Fig. 3. A. The stomach is way down in the pelvis in standing position.
B. Stenosis in the duodenum. Arterio-mesenterial occlusion.

the stomach. The stenosis must eventually be situated distal to pylorus, i. e. in bulbus duodeni.

Primary organic dilatation of the stomach

Case 4. Emaciated male, 74 years old, admitted under the diagnosis of »ileus?», had for several years suffered from dyspepsia. On arrival he had been vomiting for 2 days. Abdomen slightly distended, and a rollshaped tumour was seen extending down towards right iliac fossa. No peristalsis was seen, no ileus-sound heard. *Roentgen examination* of the reclining patient revealed a diffuse dense area extending down into the small pelvis. In left lateral position (Fig. 4 A) a horizontal fluid level was seen, about 6—7 cm long and capped by an air-bubble. When the patient was standing up the fluid level was detected to the right of columna, and somewhat shorter than in the lateral view (Fig. 4 B). The shape of the stomach and of the somewhat deformed bulbus duodeni was recognised. The diagnosis was: severe dilatation of the stomach, probably due to stenosis in the pyloric region.

Aspiration gave *4,900 cc* of liquid, whereafter the abdomen flattened, becoming soft and tender. 3 weeks later the patient was operated, and a star-shaped scar discovered on the anterior side of duodenum. Gastro-enterostomy. When discharged the patient was symptom-free.

Comments: According to our present knowledge of the formation of gas in ileus, the presence of gas in the stomach but not in the intestine indicates nearly full stenosis. Investigations by Andersen and Ringsted seem to prove that practically all gas, at least in the small intestine, is accumulated before the stenosis, being due to *swallowed air.* In the

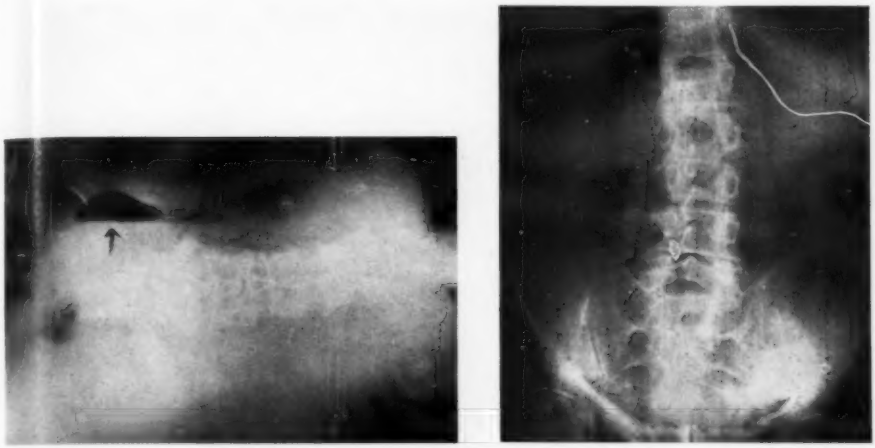


Fig. 4 A. Fig. 4 B.

Fig. 4. A. Enormous dilated stomach with fluidlevel in canalis. Left side down.
B. Upright position. The stomach riches the symphysis. Fluidlevel in canalis on the right side of columna.

present case the gas cannot flow past the pylorus, wherefore the intestine beyond this point is absolutely gas-free. Consequently this is a characteristic symptom of acute gastric dilatation due to pyloric occlusion. Here the distention and atony have evidently been as severe as to paralyse all peristaltic activity. The case shows that, because of the fluid levels, this condition is capable of resemblance to that of high ileus of the small intestine. However, size of the airbubble in a standing position and the lack of circular folds in the distended intestine should supply unmistakable evidence for the proper diagnosis. It will also be noticed that the finding of fluid levels in right iliac fossa (in left lateral position) is compatible with the location in the stomach. In other cases may predominant hyperperistalsis *suggest a colonic ileus*. An example hereof is met in the following description.

Case 5. (From the Red Cross Clinic of Oslo.)

A 60 years old woman was admitted with symptoms of ileus. There was earlier history of gastric ulcer, and now she vomited and had pain. *Roentgen examination* showed two large fluid levels in left hypochondrium and rather much gaseous distention of the small intestine, with scarce fluid levels in this part (Fig. 5 A). A barium enema was given to eliminate the possibility of a colonic ileus, suggested on the films, but showed no obstruction. The fluid levels must then be sought in the stomach, and peroral contrast was administered. A picture taken with the patient lying prone (Fig. 5 B) revealed

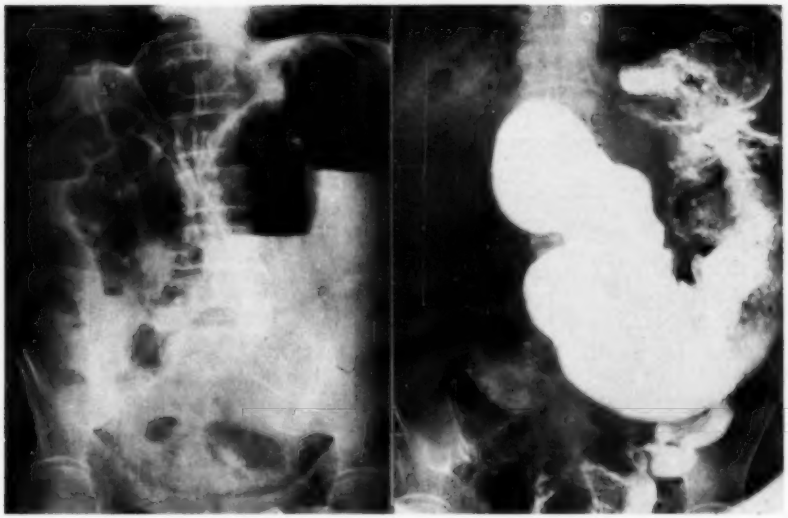


Fig. 5 A. Fig. 5 B.

Fig. 5. A. To fluidlevels in the stomach simulating a stenosis in colon. Same case after peroral barium shows dilated stomach.

a long, considerably dilated stomach with abundant hyperperistalsis. The patient was operated. A cicatricial stricture was discovered in the pyloric region. Gastroenterostomy resulted in complete recovery.

Comments: This case demonstrates the possibility of confusing, clinically and roentgenologically, the two conditions of acute gastric dilatation and colonic ileus. The dilated stomach is further seen pressing upon the small intestine, causing a sort of secondary ileus-condition of this organ, marked by relative obstruction of the passage. Similar findings are made in several cases.

Case 6. $^{7}/_{5}$ 45 a man of 75 years was admitted under the diagnosis of ileus? For the last 3 years he had been suffering from dyspepsia. Descendens of the stomach had been shown in an earlier roentgen examination. Loss of weight: 10 kgs in course of the last 2 years.

The day previous to admission the patient had severe pain, somewhat relieved after belching of gas. No filling of abdomen, no rigidity, normal intestinal gurgling.

Roentgen examination revealed 5 long fluid levels in the epigastric region and considerable gaseous distention of the intestine. The finding somewhat recalled a mechanical colonic ileus with obstruction at left flexure. The distinct gaseous distention of the descending colon, however, was contradictory to this theory, the usual picture being that of collapse of the intestine beyond the stenosis. The next picture, taken after administration of some contrast by mouth, showed the situation of the stomach cavity way down

Fig. 6.

Fig. 7.

Fig. 6. Gasfilled dilated stomach with retention in acute phlegmonous gastritis.
Fig. 7. Dilated fluidfilled stomach in acute phlegmonous gastritis. Right side down.

in right pelvis. Operation one week later disclosed a callous ulcerous tumour in the pyloric region. Resection. The patient died $^{20}/_{3}$ with signs of heart-failure. Like the preceding case, this one demonstrates the difficulty of differentiating between a long, distended stomach with *hyperperistalsis* combined with symptoms of acute abdominal condition, and a *colonic ileus*. However, peroral contrast (eventually enema) readily solves the problem.

The group of organic stenosis includes inter al. two cases of acute *phlegmonous gastritis*. Two of our six roentgenologically examined cases of acute phlegmonous gastritis show marked gastrectasis. The first one was a grossly distended stomach, showing retention for 12 hours. The gaseous distention facilitated determination of shape of the stomach, and allowed a fair estimate of thickness of the gastric wall. Also another of these cases showed severe gastric dilatation:

Case 7. $^{10}/_{2}$ 43 a man of 77 years was admitted to the surgical department II under the diagnosis of ileus? He had fever, chills, vomiting and pain. No certain clinical symptoms of ileus. *Roentgen examination* of the patient lying on his right side gave a long fluid level under left costal arch, and a dense shadow over rest of the abdomen (Fig. 7). The picture suggests the pathognomonic findings in acute dilatation of the stomach. No other abdominal organ is capable of simultaneously containing such air-bubble and such quantities of liquid. Aspiration gave $5^{1}/_{2}$ l. of gastric contents. Laparatomy after some time disclosed inflammatory infiltration of the stomach and the upper part of the intestine. The operation had lethal issue. On obduction it was found comparatively slight *phlegmonous gastritis*, more prominent *duodenitis* and *phlegmonous jejunitis*.

Atony may be more or less pronounced and occasionally lead to enormous gastric dilatations, presumably when combined with a certain degree of *aerophagy*.

Case 8. (From the Red Cross clinic.) A 60 years old man admitted with diagnosis of volvulus? Enormous distention of abdomen and violent pain. Tympanitic percussion over abdomen and no certain ileus sound. *Roentgen examination* revealed enormous

Fig. 8 A. Fig. 8 B.

Fig. 8. A. Left recumbency. Fluidlevel in the stomach $^1/_2$ m.
B. Stratification of the fluidlevel in standing position.

meteorism and a gas-carrying organ, the thickness of a thigh, in left side of abdomen. At the bottom there was a fluid level with stratification probably lying in the sigmoid colon, or in the stomach (Fig. 8). In lateral position the fluid level was nearly $^1/_2$ m. long. Fig. 8 A. Insertion of a rectal tube did not change the picture. The patient was operated upon and an enormously dilated stomach directly pushed through the incision of the abdominal wall. As in the roentgenogram there was considerable distention of the small intestine, presumably due to pressure from the dilated stomach. *A scar* was detected in the pyloric region, but no certain wound nor tumor. Mors occurred in connection with the operation. The patient's family later told that just before onset of the violent pain he had eaten a very hearty meal, consisting inter al. of large quantities of bilberries. Probably that is the explanation for the sedimentation and layer formation of the horisontal fluid level in the stomach.

Comments: The case shows absolute atony and lack of peristaltic activity, due to gastric dilatation. *The stratification of the fluid level* should supply sufficient evidence for the diagnosis of dilatation of the stomach and not of a volvulus. Our material, consisting of about 120 cases of roentgen examined acute volvulus of the colon, shows a sort of stratification of the fluid levels only in one case. This phenomenon is probably seen only in the presence of recently swallowed and *undigested remnants of food.* The case also shows another finding repeatedly met in the present material, namely simultaneous distention

of the small intestine. These develop a kind of ileus-condition, partly because of pressure from the stomach, partly because of the increased gaseous contents (swallowed air).

Secondary dilatations of the stomach

The group of secondary gastrectases, due to inflammatory processes in the vicinity of pylorus, includes several cases of cholecystitis and pancreatitis. No detailed description of the appearance of the stomach in these cases is needed. The present case represents a pancreatitis, possibly owing to primary cancer of the pancreas. *The roentgen picture* is dominated by the gas-filled stomach. The finding is rather unusual in this condition, in which gaseous distention of duodenum as a rule is the dominant feature. Positive gall-stone shadows are capable of supplying evidence for the diagnosis of cholecystitis. Common to these findings is the inconsistency of the condition compared to those in which organic changes of the stomach proper are responsible. Secondary dilatations may recede considerably when the patient is examined at intervals and in different positions.

Rather severe cases of *aerophagy* are not rarely found amongst the insane. A patient admitted to the surgical department II, was roentgenologically examined with a view to ileus. A general view in standing position showed severe gaseous distention of the stomach and a long fluid level. Also the presence of abundant amounts of gas in the small intestine, but no fluid level in this part.

In case of *perforated ulcer* the stomach is usually not much distended with gas. Our material of roentgen examined perforated ulcers makes a total of 200 cases. The stomach is occasionally found distended even when perforated, depending on the recent consume of the patient. One patient thus showed severe gastrectasis and local pneumo-peritoneum (Fig. 9). Accurate anamnesis informed that the patient, just before the onset of the pain, had been drinking crude alcohol, that probably had caused formation of rich amounts of carbonic acid and probably contributed to the perforation. The gastric wall is in this case seen as a thick brim with downward convex curvature, and is thus easily identified. Also in *volvulus* of the great bowel may an enormously distended sigmoid be seen in the middle and left parts of the abdomen. Characteristic is then convergence of the dense linear areas, corresponding to the walls, down towards the pelvis, that is the usual seat of the torsion. This symptom is considered almost pathognomonic for *sigmoid volvulus*. (Frimann-Dahl.)

If there is any doubt as to the situation of the gas, roentgenograms may naturally be taken before and after aspiration of the stomach. In

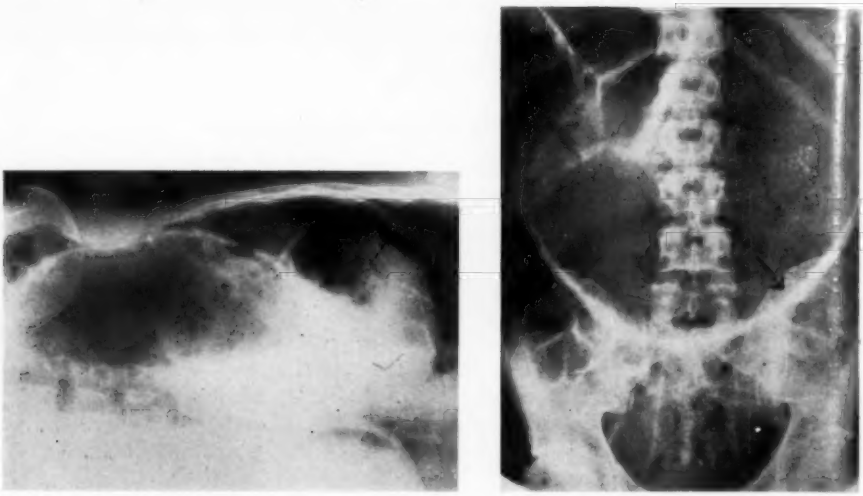


Fig. 9 A. Fig. 9 B.

Fig. 9. Gastrectasia in perforated ulcer. Pneumoperitoneum shown in lateral view.

some cases, e. g. in large subphrenic abscesses, the stomach tube may with advantage be left in when the picture is taken. Position of the tube will then decide whether the gas is accumulated in- or outside the stomach. This procedure once proved very useful to us, in the case of an abscess, the size of a child's head, and with abundant gas and an extensive fluid level anteriorly in the epigastric region. The picture was capable of resemblance to that of a dilated stomach with stenosis. But roentgenogram with inserted stomach tube gave the correct diagnosis.

The development of acute gastrectasis consequent to *traumas* to thorax and abdomen is also well-known. Severe gaseous distention of the stomach has been roentgenologically demonstrated in a number of such cases.

If the patient is exhausted and ought not to be moved, the diagnosis can be made from a roentgenogram taken with horizontal direction of the rays and the patient lying on his back. In one of our cases a bullet had penetrated the lower part of thorax and upper abdomen and caused severe distention of the stomach.

Also in *fractura columnae* is dilatation of the stomach frequently seen, possibly specially where the treatment is reposition and plaster cast. (WANGENSTEEN.) Today this method is not much used here. A pa-

tient with fractura columnae, showing abdominal symptoms is at once roentgenologically examined. A more or less distributed meteorism is usually present, and the characteristic finding, according to LAURELL, of no visible fluid level in the distended intestinal loops on horizontal direction of the rays.

Finally it also must be remembered that in some internal cases a great distension of the stomach may occur. Thus in cases of *coma diabeticum* and in *uræmi* enormous' amounts of gas and fluid may accumulate. Also these cases may easily be diagnosed and controlled on the roentgen films. (BERNING.)

SUMMARY

The different forms of acute dilatation of the stomach are accounted for, and the importance of the roentgen diagnosis pointed out. With the increasing use of roentgen examination in acute abdominal conditions, the roentgenologists will be meeting with more and more of these cases, and must therefore be able to identify the rather varying findings. Clinically many cases are simulating *e. g.* perforated ulcer, ileus or volvulus. A confident diagnosis is as a rule possible after properly made roentgen examination, not rarely with peroral contrast, or after the introduction of a stomach tube.

ZUSAMMENFASSUNG

Verschiedene Fälle von Ventrikeldilatationen werden mitgeteilt, und es wird darauf aufmerksam gemacht, dass die röntgenologische Diagnose sehr wichtig ist. Mit der steigernden Anwendung von Röntgenuntersuchungen bei akuten Bauchkrankheiten müssen diese Fälle von den Röntgenologen gekannt werden. Klinisch werden die Fälle oft mit ulcus perforans, ileus oder volvulus verwechselt. Die Diagnose kann gewöhnlich durch eine korrekte Röntgenuntersuchung gemacht werden, aber nicht selten erst nachdem perorale Kontrast gegeben ist, oder nach Niederführung einer Sonde.

RÉSUMÉ

Les diverses formes de dilatation aiguë de l'estomac sont passées en revue, et l'importance du diagnostic par les Rayons Roentgen est soulignée. Vu le recours croissant à l'examen radiologique dans les affections aiguës de l'abdomen le radiologiste rencontrera de plus en plus de ces cas, aussi doit-il être capable d'identifier les constatations passablement variées qu'il fera. Cliniquement bien des cas simulent, par exemple, l'ulcère perforé, l'iléus ou le volvulus. Un diagnostic ferme est possible, dans la règle, après examen radiologique adéquat, comportant assez souvent l'ingestion de substance opacifiante, ou après introduction de la sonde stomacale.

BIBLIOGRAPHY

1. ANDERSEN, K. and RINGSTED, A.: Clinical Investigations on Ileus. Acta Chir. Scand. 6, 475, 43.
2. BERNING, H.: Die Bauchsymptomatologi des diabetischen Komas. Ergebn. d. Inneren Med. Bd. 57. 1939.

3. FELDMAN, M.: Clinical Roentgenology. 1945.
4. FRIMANN-DAHL, J.: Røntgenundersøkelser ved akute Abdominalsykdommer. (Text-book.) Grundt Tanum, Oslo 1942.
5. LAURELL, H.: Über Röntgensymptome bei Bauchverletzungen. Upsala Läkare-Förenings förhandlingar. Bd. 43. 1938.
6. MONDOR, H.: Radio-Diagnostics Urgents. Abdomen. Masson, 1943.
7. WANGENSTEEN, O.: Intestinal Obstructions. Ch. Thomas, 1947.

FROM RADIUMHEMMET, STOCKHOLM (CHIEF: PROFESSOR ELIS BERVEN)

THE TREATMENT OF KELOIDS AT RADIUMHEMMET 1921—1941[1]

by

Folke Jacobsson

Keloids are benign proliferative fibrous tissue overgrowths. According to current opinion they are not regarded as tumours. The growth is, however, many times very tumourlike.

ALIBERT in 1810 described this overgrowth under the name of keloid (χήλη, claw) because of its strange extensions. To him a typical keloid was like a shellfish with legs implanted into the skin.

Fig. 1. A typical keloid in the sternal region.

The keloid forms a hard growth in the reticular layer of the skin. The overlying epithelium is stretched and smooth on the surface. The growth is raised above the surrounding skin, usually only about 2—3 mm, but it can be 1 cm or more prominent. It may be oval, round, linear or irregular with or without claw like prolongations. It may be like a butterfly with opened wings *(Fig. 1)* or a shellfish, implanted

Submitted for publication, July 14, 1947.

into the skin. In extent it may vary from the size of a pinhead to more than the palm of a hand. The colour varies from pink to white. A young keloid is usually pink and an old one pale (the young keloid is better vascularized than the old one).

The borderline of the surrounding skin is usually well defined. In the growth directions, however, there is a gradual transition to normal skin through a diffuse, infiltrated red zone. The keloid is movable against the subcutaneous tissues.

There usually is only one keloid but there may be two or more at the same time and on the same person. Some cases with numerous keloids have been described. De Amicis described a case with 318 keloids and Tschlenow one with 431. The keloids in the latter case were symmetrically situated. W. Reiss has described a case, a girl, 12 years old, with 210 keloids.

The keloid may be localized to every part of the skin. Keloids also occur in the mucous membrane of the mouth (de Beurmann and Gougerot and Strand). Keloids in the tongue have been described by Mook and Schmidt. Certain places seem, however, to be predisposed, as the sternal region, the shoulders and the upper part of the back. The »spontaneous» keloids are very often situated in the sternal region.

The keloid begins as a thickening in a scar after an injury or in apparently normal skin. It grows slowly and may take years to reach its maximal dimensions. It grows in the direction where there is much stretching in the skin. Spontaneous involution of a keloid is seldom seen. Perhaps in such cases it has been a hypertrophic scar instead of a keloid. Progress has been seen in connection with pregnancy by Schramek. The author has also observed such a case at Radiumhemmet, in a patient 30 years of age.

The keloid is localized to the reticular layer of the skin as a poorly circumscribed mass of connective tissue, composed of swollen interlacing bundles of hyalinized collagen. In the early stages there is moderate vascularisation, giving the red colour to the keloid, but later on the tissue is white, firm, and relatively avascular. Elastic fibrils are usually absent. The overlying epithelium is often atrophic and non-papillous (Moore). The keloid develops preferably along the blood vessels. Possibly, as Unna believes, it is formed by the adventitia of the blood vessels. This could explain the branched spreading of the keloids. As to the growth zone, Sylvén says: »The microscopic picture gives impression either of a slowly progressing infiltrative destructive growth, or rather of a diffuse transformation of the surrounding, highly differentiated, collagenous connective tissue into a keloid tissue of low differentiation, containing an abundance of free chromotrope substance.»

The primary reason for the keloid is still unknown. It is therefore generally impossible to predict in which cases there will be a keloid following an operation. SCHERMAN has characterized the keloid as »the nightmare of the plastic surgeon». It is generally accepted that there is a congenital, individual predisposition of the connective tissue to react to a trauma with pathologic new formation of connective tissue. The releasing insult may be a burn, a caustic agent, a cut, a surgical incision or an electrocoagulation, or an inflammation of the skin, *e. g.* acne, furunculosis, vaccinia, tuberculosis, herpes zoster, insect bites, etc. WELANDER has described a case with keloid in a tattoo scar but only in the red spots and not in the blue ones. There is no relation between the magnitude of the insult and the following keloid.

It has been discussed whether there are two types of keloids or not, the true or spontaneous and the false or cicatricial. In the latter case the keloid has developed in a scar and in the former there is no known releasing trauma. It is, however, nowadays believed that even in cases of »spontaneous» keloids there has been a trauma or an inflammatory lesion, but so slight that it has left no visible scar and also has escaped the patient's attention. It may have been a blunt trauma, that has caused only a bursting of the skin underneath the epidermis. There is no difference histologically between the two types of keloids.

It is often impossible to say if there is a cicatricial keloid or a hypertrophic scar. The hypertrophic tissues in such a scar are said not to exceed its borders, and therefore there is no branched spreading. In the early stages of the thickening of a scar, when therapy is most advantageous, it is usually impossible to say if there will be a keloid or only a hypertrophy of the scar, which will regress spontaneously. It is therefore difficult later on, when estimating the results of treatment, to know in exactly how many cases a hypertrophic scar has been treated instead of a keloid. From the therapeutic point of view, however, the spontaneous and the cicatricial keloid and the hypertrophic scar are an entirety.

There are two other conditions similar to the keloid, and now and then present at the same time and on the same person: Dupuytren's contracture, and the plastic induration of the penis. In these conditions the etiology is also unknown.

Experimental inoculations of keloid tissue in man and animals have been made. Keloid substance has been injected, but there were no positive results (PAUTRIER and GLASSER, NAEGELI, WATRIN and DROUET et al.).

Keloids are seen in all age groups. In clinical material of keloids the greater number are in young pepole, and there are considerably more in women than in men: This is probably due to the fact that women

are more troubled by the cosmetic disfigurement of the keloid. NAEGELI examined 3,335 healthy school children and 4.5 % had keloids. The predisposition for keloid is individual and sometimes also familial. v. ZUMBUSCH and SCHRAMEK have each described a family with keloids in three generations. At Radiumhemmet in one case there was keloid at the same place (the sternal region) in three generations. Congenital keloids have been described by BRYANT and ROSENTHAL (cited by GARB and STONE). The individual predisposition may vary during life in the same person, age predisposition. BARBAGLIA found in one patient a normal healing of wounds before puberty, but during puberty there delevoped a keloid. SAALFELD observed in another patient a normal scar before the menopause but after it a keloid. At Radiumhemmet we have had a woman, vaccinated for smallpox as a child and at the age of 19 years without keloid formation. At the third vaccination at 31 years of age she developed a keloid. Another interesting circumstance has been mentioned by GOUGEROT and CARTEAUD. They saw keloids appear in scars from herpes zoster which were 6 and 10 years old. The author has observed a case at Radiumhemmet where, in connection with pregnancy, keloids delevoped in traumatic scars, 4 years old. *(Fig. 2.)* Considering these observations it is not astonishing that some authors have suggested an endocrine cause of the keloid. So JUSTUS believes that hyperthyroidism predisposes to keloid formations. There is also a local predisposition. Keloids do not develop for instance in all burn scars.

Some races are more predisposed than others. To cite GARB and STONE: »Negroes, Hindus and Malayans are said to be more likely to develop keloidal growths than whites (BOHROD) but according to GROSSE this preponderance of keloids in the darkskinned races is due to the practice of scarification in Africa, Australia, Polynesia etc for tribal, religious or sexual motives. While keloids are universally regarded as disfigurements they are looked upon as beauty marks in Sudan (ENGELSEN), Malaya, Australia and other regions.» Keloids in negroes are often provoked by etching with saps (WALTHER).

The keloid is disfiguring and can be very embarrassing. It is usually very sensitive to touch and pressure, and pain is not uncommon. There is very often a more or less pronounced itching.

The diagnosis is usually easy. There is typically a slow growing, hard, smooth growth with branched spreading. The keloid can be impossible to distinguish from a hypertrophic scar and now and then from a sarcoid, fibroma or neurofibroma.

In old scars with keloidal nodes, especially in those caused by burning, cancer has been observed to develop. A sarcomatous degeneration of a keloid seems never to have been recorded.

Fig. 2 a. Fig. 2 b.

Fig. 2. Keloids developed in connection with pregnancy in 4-year-old traumatic scars. a) before and b) after the treatment.

The method of choice for treating keloids is with radium or roentgen rays. Numerous other methods have formerly been tried, but have not given satisfactory results. If in some cases the keloid regressed after other methods than irradiation, it probably often was a hypertrophic scar that healed spontaneously. If a keloid is surgically removed, whether with knife, thermocauterization or electrocoagulation there will nearly always be a recurrence. The new keloid is larger and often more disfiguring than the first.

L. Freund reported in 1898 that hypertrophic scars, caused by electrolysis, could be restored to skin level by roentgen treatment.

Harris in 1901 had had regress of a keloid in an operational scar after roentgen treatment.

Wickham and Williams in 1905 recommended radium for treatment of keloids.

Freund was the first to use the combined treatment of operation and postoperative prophylactic roentgen treatment. He described his method in 1909. The keloid was excised and the wound left open.

2—3 days after the operation the wound was treated with roentgen rays. The wound healed without keloid. F. recommends the combined treatment for thick and old keloids which appear radioresistant.

Some of the authors also have described their methods and results. Mostly, however, they have only expressed a general opinion based on a little material, with no definite information.

E. Collin described his results in 1929. He had treated 54 cases. 37 % were free from symptoms and in 60 % there was only a little remnant of the keloid. Most cases were treated with radium. White, hard keloids were treated with tumour doses, and soft, red ones with doses as for angiomas.

Fuhs presented 1934 his material of 829 cases of keloids and hypertrophic scars, treated 1912—1932. 174 were caused by operation and 123 by burns. 144 were spontaneous keloids. All cases were treated with radium or a combination of operation and postoperative radium (only 16 cases). In most cases the results were more or less good. There was, however, no restitutio ad integrum. The result was a scar, more or less disfiguring, but at skin level or only slightly prominent. F. only recommends the combined treatment for very prominent or radioresistant keloids. F. treats with intervals of 2—4 weeks during 1—2 years. In some cases there seem to be pronounced irradiation injuries to the skin, such as atrophy and depigmentations.

Baensch in 1937 had treated 58 cases of keloid. 36 were treated with radium and 22 with roentgen. 30 were more or less improved by radium but in 6 cases the effect was unsatisfactory. With roentgen there was a more or less satisfactory result in 15 cases. 7 were very resistant to therapy. Single doses of roentgen were given, 300—500 r with a filter of 4 mm Al. The doses were repeated, depending upon the reaction. No details are given about the radium treatment.

Hunter reported in 1942 his material of 931 patients with hypertrophic scars and keloids, treated during 1922—1941. The results were known in 673 cases. Of these, 588 were treated with roentgen and 85 with the combination operation + roentgen. In 491 cases out of 588, treated with roentgen, the scars were softer, less prominent and not so disfiguring. The earliest objective evidence of resolution of a keloid was a slight wrinkling of the skin. The author gave the treatment in series with intervals of 2—4 months, not more than 4 series a year. In each series 4 treatments were given, each of about 200 r with a filter of 3 mm Al, with two weeks between each treatment.

Garb and Stone use both ordinary roentgen and grenz rays. Out of 80 cases, 20 were free from symptoms in 1942 with filtered radiation. Two patients had keloids, that were very resistant to large doses of roentgen.

HULTBERG, 1940—1942 treated 37 cases of keloids with contact therapy (Philip's apparatus). 31 cases were cured and the other 6 much improved. Single doses of 2,000—3,000 r were given. No extra filter and a focus—skin distance of 1.8 cm. Intervals between the treatments were at least 4 months, the total dose less then 8,000 r.

HALTER had treated 30 cases in 1942 with contact therapy (ad modum Chaoul). In 14 cases the results were good. Doses up to 3,500 r, intervals of 1—6 months.

STRAND in 1945 described the results of treatment of 117 cases of keloids and hypertrophic scars at the Norwegian Radium Hospital. The releasing causes of these cases were: burns 37, congelation 1, caustic injury 3, vaccination for smallpox 12, traumatic wounds 39, operational cicatrices 15, wounds in the baby skin during birth 1, and no reason given in 9 (»spontaneous» keloids). About 68 % of the patients were women.

STRAND had had a complete or approximate flattening of the keloid down to skin level in 57 %. In 32 % there was good regression but with a remaining, distinct prominence of the keloid. All cases were treated with radium. The treatment was done at a radium skin distance of 7 mm with a filter of 0.7—1 mm Pt. The radiation was heavily protracted. Treatment was given with a dose of 1,400—2,000 r in 3—4 days. Further treatment was given in 36 cases. Total doses of 4,000—5,000 r. A keloid in the mucous membrane of the bucca was treated by implantation of radium needles.

Radium is said to give the best cosmetic results. In other respects the opinions are divided, as to whether the best effect is achieved by radium or roentgen. It is generally accepted, however, that large keloids ought to be treated with roentgen. Keloids in children and young individuals are said to react more readily to treatment than those of older people. A young, vascular keloid reacts better than an old, solid, avascular one. Radium is chiefly used at short distances. Extirpation is thought advisable with keloids thicker than 5 mm, with subsequent prophylactic radiotherapy. It has been proved that if an irradiated keloid has been made to recede there is no recurrence.

The author's material comprises 625 cases of keloids treated at Radiumhemmet 1921—1941. The cases have been followed until the keloid has totally regressed, or otherwise at least three years. The keloid had earlier been extirpated in 112 cases with following recurrence. The releasing trauma is to be found in *Table II.* In the cases with unknown cause 83 of the 101 cases were situated in the sternal region. The localization in cases with keloid or keloids only on one part of the body is recorded in *Table I.*

Table I.

Localization.

(In 563 cases with keloid only on one part of the body.)

Face 79, Neck 97, Back 16, Breast 136 (the sternal region: 121), Abdomen 6, Arm 190 (the shoulder region: 118), Leg 37.

In 563 cases the keloid was localized to one part of the body. 62 of the patients had keloids on two or more parts of the body.

Among the patients with age recorded (620), 72.5 % were women and 27.5 % men. The preponderance of women may be explained by the fact that they consult a doctor more often than men, because of the disfigurement of the keloid. The age distribution is recorded in diagram *(Fig. 3)*. (The figures have not been corrected with regard

Fig. 3. The agedistribution of the material.

to the decrease of the population with increasing age.) There is a peak at 5—9 years the »vaccination» peak. Most keloids are here caused by vaccination for smallpox. The patients usually have been vaccinated at 6—7 years of age. A second peak, the »cosmetic» peak, is found at 20—24 years. People in these ages, especially women, are very watchful of disfiguring growths in the skin. It may be a keloid or a naevus that will be removed with a subsequent keloid. Older people are not likely to consult a doctor for keloid as often as younger.

In 21 cases a familial predisposition is mentioned. However, the patients have not always been specially questioned on that point, and

the figure therefore is probably too low. In one family three sisters had a keloid in the sternal region at the same age (12 years). It seems reasonable to believe in a hormonal influence in such cases. A pair of twins were vaccinated for smallpox and developed keloids at the same time. They, however, reacted differently to the same treatment. Both had their keloids excised immediately before the radium treatment that was then given prophylactically. The keloids were more than 5 mm thick. One is cured, but the other has a prominent keloid in the border line of the first treatment field. The treatment field probably was too small in the unsuccessful case. — In this connection a family with keloids may be mentioned, though it does not belong to the material. Mother, son and daughter had pronounced keloids, caused by various agents. The mother had 25 large keloids over her whole body. She was very troubled by her growths. — 549 cases have been treated with radium exclusively, 24 with a combination of roentgen and radium, and 25 exclusively with roentgen. A combined treatment has been used in 27 cases (the keloid has first been excised and within 10 days the scar has been prophylactically treated with radium or roentgen).

Brachyradium treatment has been used throughout, except in a few cases which were treated with teleradium. The methods of treatment have varied, but, except in some cases during the first years, only the gamma and secondary beta radiation have been utilized. In the first three years flat containers of 10 mgm radium element per square centimeter were used. The filter was made up of 0.25 mm German silver and a sheet of tin foil. In most cases an extra filter of 0.5—1 mm lead was used. Usually the flat containers were fixed directly on the treatment field. In 1924—1935 tubes were used containing 5 or 10 mgm radium element. The 5 and 10 mgm tubes had a length of 11 and 20 mm respectively, with the radium in an active length of 7.5 and 16.5 mm respectively. The filter was made up of the capsule wall, corresponding to 1.1 mm of lead in addition mostly to an extra filter corresponding to 0.5—1 mm of lead. The tubes with or without extra filtration had been set in moulds of dental compound. The distance between the outer walls of the applicators and the treated area usually varied between 1.5—5 mm.

Since 1936 we have used a technique, elaborated and described by Strandqvist. The principle of the method is the use of standard applicators consisting of individual glass capsules for each radium tube by means of which the tubes are always fixed at exactly the same distance from each other and from the surface of the skin. Thus the intensity of the gamma-radiation from every applicator can be previously determined and the treatment time for any desired dose can be read off directly from a dosage chart. The distance between the axis of the

radium and the surface of the skin is 4.5 mm. Two types of containers are used: a needle with external dimensions of 15 × 2.5 mm, containing 10 mgm of radium in an active length of 8 mm and a tube with external dimensions of 20 × 2.8 mm, containing 8 mgm of radium in an active length of 15 mm. The wall of the 10 mgm containers consists of 0.35 mm Au + 0.35 mm Pt, and that of the 8 mgm tubes of 0.35 mm Au + 0.50 mm Pt, equivalent to 0.5 mm Pt or 1 mm Pb. No extra filter has been used. The distance between the axis of two needles is 4.5 mm, and of two tubes 5 mm. — Only preparations containing radium salt in the form of sulphate have been used.

Clinical experience has shown that conformity between dosage and skin reaction will be found if the dose has been calculated in accordance with the average of the intensity at a central surface point and at each successive point down to a depth of 1 cm (Strandqvist). We therefore now always calculate the dose as »average dose» in 1 cm tissue layer. According to Strandqvist this dose is approximately the same as the dose at a depth of 3 mm under the surface.

Before 1936 there were many difficulties involved in calculating the dose in individual cases from the available data because the position of the containers and the distance from the surface has not been defined exactly enough.

The dose has, however, been calculated in a number of cases by Dr. Benner at the Radiophysical Institute, Radiumhemmet. The dose has been calculated at a depth of 3 mm under the surface to approximate our present doses. The unit of radiation intensity chosen is the r unit per hour, and a value of 7.5 r per hour, equivalent to one Imc (Sievert). In 1921—1923 a single dose of 300—2,000 r was given; in 1924—1935 usually 1,000—1,500 r. After at least 2 months, further treatment was given in about half the cases. The dose then varied depending on the first given and the reaction of the keloid. Since 1933, usually only one treatment has been given. Since 1936, the dose has varied between 600 and 1,200 r, usually between 850 and 1,000 r. As an example of the treatment time, it may be mentioned that 900 r are delivered in 2 hours by an applicator containing 10 needles (100 mg radium) arranged in one row.

The purpose of the treatment has been to obtain a soft scar in skin level. The dose, however, ought not to cause appreciable irradiation injuries to the skin, such as atrophy, teleangiectasis or pigmentation. It is better to have a slightly prominent, not very disfiguring keloid without trouble than a disfiguring, easily vulnerable scar.

The results of the treatment are recorded in *Table II*.

Table II.

Group	The releasing cause	Class I	II	III	IV	V	Number of cases
I	Burns and congelation (only 1 case)	82 (71.3 %)	17	14	2		115
II	Caustic agent	9 (c:a 75 %)	2	1			12
III	Vaccination for smallpox	82 (75.2 %)	13	8	3	3	109
IV	Mechanical injury	56 (88.9 %)	6	1			63
V	Operation with knife...	95 (83.3 %)	11	7	1		114
VI	Electrodesiccation	24 (c:a 77 %)	5		1	1	31
VII	Infection	45 (65.2 %)	12	8	3	1	69
VIII	Different causes in the same patient	4 (c:a 36 %)	1	6			11
IX	Unknown	63 (62.4) %	23	11	2	2	101
	Total number of cases:	460 (73.6 %)	90 (14.4 %)	56 (9 %)	12 (1.9 %)	7 (1.1 %)	625

The keloids are gathered in groups according to the releasing cause. The results have been divided in five classes. Class I = the scar quite soft and in skin level or only slightly elevated. Class II = considerable regression but a slight remaining prominence of the keloid. Class III = evident regression. Class IV = slight regression. Class V = unsatisfactory effect.

The cases in class I in the different groups have been calculated in per cent of the total number of cases in each group. All cases in each class have been calculated as percentage of the total number of cases. There was a total regression in 73.6 %, considerable in 14.4, evident in 9, slight in 1.9 % and unsatisfactory effect in 1.1 %. In 4 of the 7 cases in the last class the dose was only between 600—800 r. In these cases the results might have been better if the dose had been higher, *e. g.* about 1,000 r.

The regression of the keloid was usually rather slow. In the majority of the cases the keloid had totally regressed two years after the treatment and in many cases after 1—1½ years. Some cases, however, showed a regression after many years. The itching and pain soon ceased as the keloid regressed. In some cases, however, there is occasional itching in the scar many years after the keloid has regressed. This ought to be interpreted as caused by dryness in the skin in the treated area as it usually disappears after greasing the skin with vaseline.

When comparing the results in the different groups one should be careful in drawing conclusions. Because of a possibly uneven distribution of hypertrophic scars which could not be differed from keloids in

the different groups, can lead to false conclusions. Further, the number of cases in some of the groups is too small to permit of any certain conclusions. It may, however, be possible to say, that the results are better with keloids caused by mechanical injury or operation (88.9 and 83.3 % respectively in class I) than with those caused by infection (tbc, furunculosis, herpes zoster etc.), and those without known reason (67.2 and 62.4 % respectively in class I). When there are more than one keloid and different releasing causes the results are poor, only about 36 % in class I. In 9 of these 11 cases there was a combination of a keloid in the sternal region and other regions. These ought to be counted as the most genuine keloids. If the results before and after 1936 (the year of the beginning of our present method) are compared, the results for 1921—1935 are 73.5 % in class I. For 1936—1941 it is 73.7 % in class I. So compared there seems to be no difference in the results. Since 1936, however, the doses as a rule have been lower than during 1921—1935. The results are also cosmetically better during 1936—1941.

An attempt has been made to determine the suitable dose from the material, treated according to STRANDQVIST's method. Cases with one keloid, only treated once, have been compared (188 cases). It was found that there was a difference between cases treated with doses less than 900 r and those with 900 r or more *(Table III)*.

Table III.

	Class I	II	III	IV	V
$<$ 900 r (118 cases).....	92	8	13	2	3
$\leqq$ 900 r (70 cases)	55	15	—	—	—

In the cases treated with less than 900 r the results were very good in 84.7 % (Class I + II) and in the cases treated with $\leqq$ 900 r very good in 100 %.

25 keloids have been treated with roentgen exclusively. The distribution of groups and classes is found in *Table IV*.

There are about 56 % in class I of all cases treated with roentgen. These are keloids caused chiefly by burns, infection, and those with no known etiology. In the last group all keloids were situated in the sternal region. The results are not comparable with the cases exclusively treated with radium. Roentgen has been given to thick and large keloids, not suitable for radium treatment. The dose has varied in every case. Sometimes single but usually divided doses have been given. The total doses have been more than 1,000 r (with backscatter)

Table IV.

Results of roentgen treatment.

The releasing cause	Class I	II	III	Number of cases
Burns	5	3	2	10
Caustic agent		1		1
Mechanical injury	2	1		3
Infection	5	2	1	8
Unknown (all are keloids in the sternal region)	2		1	3
Total	14	7	4	25

in 21 cases (in 10 more than 1,500 r) and 22 have got only one series of treatments. In cases of keloids caused by burns one ought to be careful with the treatment. After total doses of more than 1,000 r, the skin seems to be easily damaged.

The results referred to the age of the patient are to be found in *Table V.*

Table V.

Ages of the patients	Class I	II	III	IV	V	Number of cases
0— 5 years	38 (c:a 79 %)	5	4	1		48
5—10 »	81 (77.1 %)	11	11	1	1	105
10—15 »	34 (c:a 62 %)	12	6	2	1	55
15—20 »	47 (c:a 72 %)	8	6	3	1	65
20—30 »	120 (71.4 %)	24	18	3	3	168
30—40 »	67 (77 %)	16	3		1	87
40—50 »	40 (c:a 74 %)	9	4	1		54
> 50 »	29 (c:a 76 %)	4	4	1		38

Age not recorded in 5 cases.

The results in 10—15 year age group seem to be not as good as for the other ages. Perhaps there is some connection with the puberty.

The results with special regard to the duration of the keloid at the beginning of the treatment are shown in *Table VI.*

The best results seem to be achieved if the keloid is less than 1 year. It is obvious that the keloid with increasing age is less radiosensitive.

Table VI.

Duration of the keloid	Class I	II	III	IV	V	Number of cases
0— 6 months	86 (82.7 %)	10	8			104
6—12 »	112 (81.8 %)	14	10	1		137
1— 2 years	67 (c:a 75 %)	9	8	2	3	89
2— 3 »	41 (c:a 71 %)	10	6		1	58
3— 5 »	32 (c:a 74 %)	7	3		1	43
5—10 »	32 (c:a 56 %)	11	7	5	2	57
> 10 »	22 (c:a 50 %)	14	7	1		44

Duration of keloid recorded in 532 cases.

In 27 cases the keloid first has been excised and the wound suturated. Within 10 days immediately after the sutures are removed the scar had been prophylactically treated with radium or roentgen. The classes and groups are to be found in *Table VII.*

Table VII.

Op. + postoperative prophylactic irradiation.

		The releasing cause	
Class I	20	Burns	1
II	3	Vaccination for smallpox	5
III	3	Mechanical injury	3
IV	1	Operation with knife	7
		Electrodesiccation	2
Of totally 27 cases about 74 % are in Class I.		Infection	2
		Unknown (all are keloids in the sternal region)	7

The result in class I is about 74 %. So there is no difference from the results of treatment of all cases. The cosmetic results, however, often are poorer after the combined treatment than with only irradiation. As proof for the effect of the prophylactic treatment the author observed a case when a keloid delevoped in the area between two radium applicators, which had not been brought close together. — The doses given prophylactically are the same as otherwise given to keloids.

The results of the treatment of keloids in the sternal region are of special interest. In the present material there are 121 cases with the keloid situated only in this region, 100 of them in women and 21 in

m n. About 60 % are in class I. The rather poor result is partly e:plained by the fact that the treatment field has been too small since in many cases the keloid has shown regression centrally but has co ıtinued to grow at the periphery. It must be emphasized that the tr atment field in these cases must cover a margin at least 5 mm br oad of the surrounding apparently normal skin, especially in the g owth directions. The growth of the keloid in these cases often is like that of a basal cell carcinoma.

The keloid had been surgically removed one or more times before the treatment at Radiumhemmet in 112 cases with subsequent recurrence. In 17 cases the keloid had been operated on two times or more. Of the 112 treated cases c:a 67 % were in class I. The result is therefore poorer when compared with the whole material. In about one third of the cases the keloid was situated in the sternal region, which may explain the difference in part.

Skin necrosis has been found in 9 cases, 8 of them treated before 1934. The keloid in all these cases had developed after a burn. Five necroses healed in short time with conservative treatment but 4 had to be excised. In all 9 cases the keloid was situated in regions, known to be sensitive to irradiation. It must once more be emphasized that treatment of keloids following burns requires special caution.

Discussion

It is evident from the investigation that a keloid ought to be treated with radium before it is more than one year old, because it then becomes gradually less radiosensitive. The best results are obtained by keloids caused by mechanical injury or operation and the poorest in keloids in the sternal region and in cases with more than one keloid and different causes. In the last mentioned cases irradiation ought to be given prophylactically to every significant lesion of the skin. Since 1936 we have treated with standard applicators according to Strandqvist. The dose has been counted as average dose in 1 cm tissue layer and has varied between 600 and 1,200 r. A dose of 900 r, for instance, is delivered in 2 hours by an applicator containing 10 needles (100 mg radium) arranged in one row. The dose has been dependent on the age of the keloid, its size and localization, its cause etc. A careful dose must be given to keloids caused by burns. The skin tolerance is here decreased and there is risk of necrosis. If there is no definite regress of the keloid after 1—1½ years, and there still are pronounced symptoms such as itching and pain, a second treatment should be given. In most cases, however, one treatment will be sufficient. In radioresistant cases it is better to be statisfied with a slight

regression or only a cessation of the growth of the keloid and disappearance of the subjective symptoms than to cause severe radiation injuries to the skin, which can be much more disfiguring than the keloid. By irradiation of »spontaneous» keloids, especially those in the sternal region, the treatment field should be large enough. It must cover a margin at least 5 mm of the surrounding apparently normal skin, especially in the growth directions. The growth in these cases is often like that of a basal cell carcinoma. Large keloids should be treated with roentgen because the dose then will be more uniform than with a large radium applicator. When a divided dose is given, the borders of the treatment field ought to be varied slightly to make the transition from irradiated to non irradiated skin area as unperceivable as possible. The combination of operation and subsequent irradiation is as a rule not to be recommended. The results of irradition only are so good that this treatment always should be tried first. If the keloid is old, thick and pale and thus probably radioresistant, it may, however, be necessary to excise it and give prophylactic irradiation. The scar after operation will often be more disfiguring and visible than the keloid as it is necessary to excise the keloid with broad margin out in normal tissues. Furthermore the incision must be made so that there will be the least possible stretching in the scar. Otherwise there is a great risk for recurrence in spite of the prophylactic irradiation. In stringlike keloids, restrictive to movements, or over joints, plastic operations often must be done.

SUMMARY

At Radiumhemmet 625 cases of keloids have been treated during 1921—1941. In 112 cases the keloid had earlier been surgically excised one or more times with subsequent recurrence. 549 cases were treated with radium, 24 with radium and roentgen and 25 exclusively with roentgen. The keloid was excised in 27 cases, and then within 10 days the scar was prophylactically irradiated. Total regression of the keloid was obtained in 73.6 %, considerable in 14.4 %, evident in 9 %, slight regression in 1.9 % and unsatisfactory effect in 1.1 %.

ZUSAMMENFASSUNG

In den Jahren 1921—1941 wurden im Radiumkrankenhause 625 Fälle von Keloid behandelt. In 112 Fällen war das Keloid früher bereits ein oder mehrere Male herausgeschnitten worden — mit nachfolgendem Rückfall. 549 Fälle hatten Radiumbehandlung erhalten, 24 Fälle Radium- und Röntgenbehandlung und 25 nur Röntgenbehandlung. Das Keloid wurde in 27 Fällen ausgeschnitten und die Narbe innerhalb von 10 Tagen nach der Operation prophylaktisch strahlenbehandelt. In 73.6 % wurde totaler Rückgang erzielt, in 14.4 % bedeutender, in 9 % deutlicher und in 1.9 % leichter Rückgang. In 1.1 % der Fälle war die Wirkung unbefriedigend.

RÉSUMÉ

Au Radiumhemmet, 625 cas de cheloïdes ont été traités de 1921 à 1941. Dans 112, la cheloïde avait été excisée précédemment à une ou plusieurs reprises, mais avait récidivé. 54 cas furent traités par le radium, 24 par le radium et les Rayons Roentgen, et 25 seulement par ces derniers. La cheloïde fut excisée chez 27 malades, et dans les 10 jours qui suivirent l'opération la cicatrice fut soumise préventivement a l'actinothérapie. La régression obtenue fut totale dans 73.6 % des cas, considérable dans 14.4 %, évidente dans 9 %, et légère dans 1.9 %. Dans 1.1 % des cas les résultats ne fut pas satisfaisant.

BIBLIOGRAPHY

Baensch, W.: Strahlentherapie 60: 204, 1937.
Barbaglia, V.: Ref. Zbl. Hautkrh. 31: 338, 1929.
de Beurmann and Gougerot: Ann. de Dermat. 151, 1906.
Bohrod, M.: Arch. Derm. & Syph. 36: 19, 1937.
Collin, E.: Acta Radiol. 10: 186, 1929.
Freund, L.: Wien. med. Wchnschr. 63: 2355, 1913.
—, Fortschr. a. d. Geb. d. Rtgstr. 34: 713, 1926.
Fuhs, H.: Med. Klinik 30: 160, 1934.
Garb, J. and Stone, M. J.: Am. J. Surg. 98: 315, 1942.
Gougerot and Carteaud: Ref. Zbl. Hautkrh. 31: 496, 1929.
Halter, K.: Strahlentherapie 71: 102, 1942.
Harris cit. by Freund.
Hultberg, S.: Acta Radiol. Suppl. LIV, 1943.
Hunter, A. F.: Radiology 39: 400, 1942.
Justus, J.: Arch. f. Dermat. 127: 274, 1919.
Mook, W.: Arch. Dermat & Syph. 10: 304, 1924.
Moore, R.: Textbook of Pathology. Philadelphia & London 1944.
Naegeli: Bull. Soc. franç. de derm. et syph. 38: 905, 1931.
—, » » » » » » » 38: 950, 1931.
Pautrier and Glasser: Bull. Soc. franç. de derm. et syph. 38: 950, 1931.
Reiss, W.: Arch. f. Dermat. u. Syphil. 56: 323, 1901.
Saalfeld, E. and Saalfeld, U.: Jadassohns Handbuch d. Haut u. Geschlechtskrankheiten XII/2, 1932.
Scherman, B.: Radiology 1: 454, 1932.
Schmidt, W.: Dermat. Wchnschr. 99: 1341, 1934.
Schramek, M.: Arch. f. Dermat. 99: 207, 1910.
Sievert, R.: Acta Radiol. 15: 193, 1934.
Strand, S.: Acta Radiol. 26: 397, 1945.
Strandqvist, M: Acta Radiol. 20: 1, 1939.
—, » » 22: 808, 1941.
Sylvén, B.: Acta Radiol. Suppl. LIX, 1945.
Unna, P. G.: Die Histopathologie der Hautkrankheiten. Berlin 1894.
Zumbusch, L. v.: Arch. f. Dermat. 87: 426, 1907.
Walther, E.: Die Medizinische Welt 9: 1006, 1935.
Wallin and Drouet: Bull. Soc. franç. de dermat. et syph. 38: 948, 1931.
Weander, E.: Nordiskt med. Arkiv n:r 3, 1893.
Wickham and Williams cit. by Baensch.
Wolf, M.: Wien med. Wchnchr. 86: 722, 1936.

SOLUTION OF TECHNICAL PROBLEMS CONNECTED WITH ECONOMICAL LIGHT-WEIGHT APPARATUS FOR MASS MINIATURE RADIOGRAPHY[1]

by

Kaj W. Noschis

Towards the middle of the year 1946 screen photography in the towns of Finland and in its industry was centralized, the intention being to bring about within this sphere paid activity for the public good at cost price. This task was confided to a newly founded Company, in which the leading health care organizations of the country were interested as shareholders. Owing in part to the extremely great difficulties in obtaining material caused by the post-war situation and in part to the need for economy, owing to the Company being an enterprise working at the lowest possible cost, the advantageous obtaining of suitable equipment for the undertaking became a question of the first magnitude. In the following a short account will be given of the manner in which the problem of obtaining an equipment of fully satisfactory quality and nevertheless at the same time low purchase price and minimal service costs was solved. Seeing that more or less analogous conditions exist in other countries harassed by the war, this relation ought to be of interest, the more so, because it gives an account of our quite new technical solutions of certain problems. The equipment already in existence in this country consisted, with two exceptions, of German half-wave apparati, in part of the original Siemens model with a tube-unit, to be raised or lowered at will, in part of types furnished with a so-called »patient lift». The two other apparati were four-valve ones of Swedish construction. Besides the difficulty of obtaining spare parts for the German apparati, it was found that the insignificant amount of foreign currency which had been reserved for new roentgen apparati was also a negative factor to be taken into consideration. The two Associations which

[1] Submitted for publication, July 1, 1947.

d ring the past years had carried out large-scale screen photography, h d incurred costs, which, above all as regards apparatus-service a d motor-car transport, would have to be reduced by considerably n ore than 50 % to be acceptable in the calculations used as a basis f r the operating of the new undertaking. The latter could not, as had b en the case with the above-named Associations, count upon receiving S ate grants or donations from home and abroad.

In Finland it has been found financially impossible, at least for the n xt few years, to make use of the so-called average size for screen photography (70 × 70 mm or 60 × 60 mm). We have been compelled to keep to the cine-film size (24 × 24 mm). In the same way we have until further had to abstain from the thought of four-valve or condensor apparati. Instead, we decided to go in for a half-wave apparatus, extremely easily transportable and easy to assemble.

The condition that the apparatus had to be easily transportable was not fixed solely to render speedy assemblage possible. The fact was, that it had been found in practice, that one of the above Associations, which at great cost had produced special motor-cars for transport of the apparatus, had encountered great difficulties, not only in consequence of the often very difficult road conditions in this country, but also owing to the very strict rationing of fuel. Besides, as already mentioned, the account for motor-cars showed extremely high costs, both as regards purchase prices and service.

After having carried out a number of experiments, and basing ourselves on earlier experience in this branch, we found that we could obtain screen-photo-technically and medicinally satisfactory pictures by using effects of 50—70 mA, 85—90 kV, in combination with scrupulously well executed dark-room work.

As a sequel to negotiations with the only enterprise in this country which builds roentgen apparati of purely Finnish manufacture, we decided, in co-operation with Civil-Engineer A. Pehrsson, the head of the said firm, to build an apparatus based on new principles, and this resulted in the so-called Penograph model. As will be seen from the illustrations, the control panel with its manoeuvring organs has been built on to the high tension transformer (Fig. 1). From the control panel again there rises a chimney-like erection, representing the hood of the roentgen tube, which is fitted in a vertical position. By means of this construction flexible high tension cables have been entirely eliminated, it having been possible to achieve the high tension connection roentgen tube — transformer by means of partly detachable bakelite insulators, which, together with a ray-protected American machlett-tube, have been built into the »chimney» of the apparatus, thus forming a high-tension-protected unit. For transport

Fig. 1.

Fig. 2.

Fig. 1. Roentgen apparatus without protective screen, comprising high tension transformer at bottom, control panel (switchboard) in centre and at top roentgen tube in its protective hood fitted with window.

Fig. 2. Position of roentgen tube on top of control panel, firmly fixed to same by means of bakelite-covered wiring (protective hood removed).

the chimney is detached from the body of the apparatus, while the roentgen tube can be attached or detached by a single movement (Fig. 2). The whole of the equipment, with the requisite blower and 25 m of connection cable, consists of only three carrying cases and has an assemblage time of about 5 minutes (Fig. 3). The total weight of the whole screen photography equipment amounts to 350 kgs, which is only one third of the weight of the corresponding foreign apparati to be found in this country.

The manœuvring organs consist of 1) the main switch, 2) line compensator, 3) filament resistance, 4) high tension regulator and 5) time switch. The latter is based on the »electron-tube condensor» principle and consists of six push-buttons with indicated times of exposure of varying length, a system that facilitates the work of the photographer, as he need not have recourse to a time clock, but can obtain any desired time of exposure by simply pressing a button. Depending on the optics used, the times can be predetermined as required (the exposure times of the apparatus shown in the illustration are the following: 0.4, 0.6, 0.75, 1.0, 1.4, 1.8 sec.). In practice a regulation of the time for different patients has been found to be

Fig. 3. Apparatus disassembled for transport in 3 carrying cases, lids left open.

most to the purpose and only in extreme cases is it necessary to have recourse to an alteration of the high tension regulator, which is usually set at 80 kV. The measuring instruments visible on the control panel are the line voltage or mA meters. For a closer description of the construction of the apparatus readers are referred to the illustrations and text alongside. — — —. For motor-car transport a Jeep with a standard trailer is used, this having an extremely favourable effect on the costs, on the speed and on the possibilities of travel under difficult road conditions.

A thoroughgoing innovation carried out on all screen photo apparati belonging to the Company is that cameras of the Leitz and Robot types have been taken away and that the objectives in question have been built into cameras of simple, reliable construction, manufactured in this country and carrying 25 m. of film. By this means 1,050 pictures can be taken per 25 m. of film, instead of only 650 pictures, as is the case with the German short 1.7 m. film cassette. This procedure has proved to be extremely economical and also leads to a considerable saving of time in mass photography, as only one film loading takes place each day. (Fig. 4). In this connection it may be mentioned that experiments, now almost completed, with a mirror-optic, built in Finland according to Professor Väisälä's system for the astronomic camera, have shown good results with a calculated actual intensity of light of 1 : 0.98. — — — Such an extreme intensity of light renders it possible — even when using a roentgen apparatus of the above-mentioned small capacity — to shorten the times of exposure to less than a quarter of the present times. The Väisälä-optics, the relatively small costs of which are acceptable even in our circumstances, thus

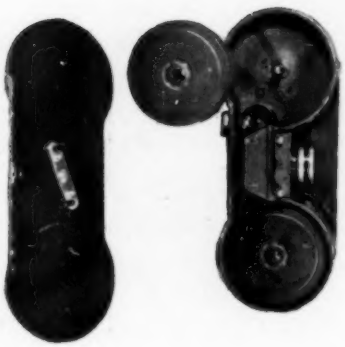


Fig. 4. Fig. 5.

Fig. 4. Camera with special large size cassettes for 25 m. film.

Fig. 5. The mechanical »Patient-sinker» in use. The weight of the person being photographed causes the platform to move downwards at even speed to the desired level, where it is automatically locked by a manual brake. When the patient steps off the platform, this rises to its highest original level.

allow of pictures being taken with our easily transportable apparatus of comparatively small capacity, in which pictures the movement unsharpness is practically as negligible as when heavy four-valve and condensator apparati are used.

We have also gone in for the construction of a wholly automatically self-regulating time clock for the Finnish screen photographic apparatus, named model Penograph. After having made a closer study of the principles according to which the so-called »Morgan-Hodges-Photo-Timer» is constructed, we found that, in Finland to-day, the obtaining of requisite parts met with practically insuperable difficulties. We have therefore of late experimented with a simple construction of our own invention, which is based upon purely mechanical principles and therefore is easy to handle. It is based on the fact that the relation between the weight of different patients agrees fairly well with the length of time needed for exposure. In this connection we do not omit to stress that the good results achieved when a skilled roentgen photographer determines the time of exposure by eye prove that an extremely exact adjustment of the time of exposure in the different

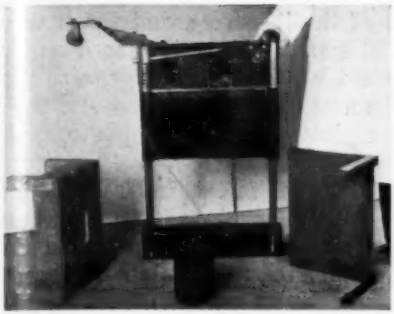


Fig. 6.

Fig. 7.

Fig. 6. Frontal close-up of the »Patient-sinker», showing the gearing mechanism, based on mechanically regulated even movement.
Fig. 7. General view of the Penograph in use, completely assembled, the carrying cases being used as base and with the protective screens in place.

cases is not required. Owing to this, and as the timer, at least in theory, works with a large »margin», there is every warrant for a solution, basing itself on the varying weight of the patients. The construction is based on a spring platform, running on ball-bearings, which occupies different heights according to the weight of the respective patients. The movements of the platform are transferred by means of levers to the regulating mechanism of a time clock, so that the longer the movement which the weight of the patient compels the platform to make, the longer are the times of exposure, and vice-versa.

When the Penograph was in process of construction, it was found to be impossible to obtain in this country a motor suited for the so-called »patient lift» (electric motors of domestic manufacture are supplied almost exclusively to the War Reparations industries). Had such a motor therefore had to be ordered and obtained from Sweden, this would have entailed a delay of at least 6—8 months in the utilising of the finished roentgen apparatus. In order to avoid such a delay, we were therefore compelled to bring out a »patient lift» of our own construction, which when ready was named »Patient-sinker». As will be seen from the photographs alongside, the principle is merely that the patient's own weight presses the lift downwards; a gearing with a built-on »centrifugal brake» enables the movement to take place at even speed. (Fig. 5). When the patient steps off the platform, the lift rises again to its maximum height by the downward movement of a counter-

weight, which is attached to same by means of a wire cable and re l. A height of 45 cm from the floor has shown itself to be suitable as the highest position for the platform of the lift. To assist the patient to step on to the platform, a buffet 20 cm. in height is placed on the floor alongside the lift. As is the case with the motor lifts, also this construction has been provided with an extra platform 20 cm. high, which can be placed on top of the other platform when the photographing of children is in question.

The »Patient-sinker» has been found to act to the full satisfaction of both the photographer and the patients. It has never happened that any of the patients has sunk too low, neither has anyone found the apparatus inconvenient. In practice it has been found to be speedy in the serial work, while the simple construction renders it very reliable. For these reasons we intend in future to make use of similar types, which can be constructed for a mere fraction of the cost of a motor lift. Service costs are negligible and owing to its small dimensions, light weight and insensitivity to shock, the lift is easily transportable by car. (Fig. 6).

To sum up, it may be said that the technical solutions of problems and the practical advantages obtained thereby, must, as far as the Penograph is concerned, be regarded as consisting of and arising from the following data and circumstances:

1) The weight of the apparatus has been reduced to not more than 350 kgs, it is therefore very easily transportable in comparison with the apparati formerly used of more than twice the weight. Thus the Penograph can be transported with ease *e. g.* in the trailer of an American army Jeep. Further, the apparatus consists of only three separate units, its assembling and packing have been simplified, so that this takes only one man not more than 5 minutes.
2) Purchase price and service costs are substantially reduced through the total elimination of flexible high tension cables, as also by the use of a semi-automatic mechanical patient-lift, needing no electric motor.
3) Operating costs and the quantity of film required are reduced by an improvement in the camera-casette construction, which allows of 1,050 pictures being taken on a standard film 25 m. in length. At the same time the photographic speed is increased, owing to casette-changing no longer being required. As the time of exposure is automatically determined by means of a mechanical photo timer, specially constructed for the purpose, this greatly facilitates the work of the operators.

c) By being easier to transport, easier to assemble and by operating costs being reduced also in other respects, it will be financially possible to visit and photograph at their place of work also small groups of less than 100 persons, whereas, with bigger and less convenient apparatus, this was found to entail waste of time and a financial loss.

Finally, an account should be given of the arrangements for providing enlarged copies of the separate film pictures, these copies being intended for individual use. This method, which, so far as we are aware, has not been practised elsewhere, at least not on any large scale, is based on ordinary enlargement of single thorax images, from the 24 mm cine-film size to a size of 80—100 mm, either on film or on photographic copying paper. When required the copies are placed at the disposal of the respective medical man, hospital, insurance company or other medicinal instance, while the original film is filed in the Central Archives for all screen photographs taken in Finland, which has been set up for the public good by the Company mentioned in the foreword. Thus the chest roentgen pictures obtained by means of ordinary screen photography can serve also individual purposes for the patients in question, with regard to both pathological and normal lung-, heart- and other roentgenological findings. This has never before been the case in mass photography, which in general is carried out solely with a view to the discovery and registration of tuberculosis of the lungs. These enlarged copies of the chest roentgen status, 80—100 mm in size, can naturally be scrutinized without projection, as is the custom with so-called average size screen photography (60—70 mm). The sharpness of detail of the images is of course somewhat lessened by the magnification, but with technically impeccable execution this has no influence worth mentioning on the diagnostical value. The price of the copies is a mere fraction of that of the corresponding original films and delivery takes place immediately and conveniently from the above-mentioned Central Archives to the various medicinal instances and also to the individuals photographed, for immediate use in pathological cases and also as regards normal cases for control and comparison in the future.

SUMMARY

An account of an easily transportable light-weight apparatus for Mass Radiography, built in Finland and characterized by specially speedy erection and easy handling. High tension cables are eliminated, a mechanical patient lift without a motor, fitted with a timer working in connection therewith automatically releases the different times of exposure required. A special cassette for 25 m. of cinefilm reduces the film

requirement by about 40 %. The quality of the image is the same as obtained by ordinary standard apparatus. An account is given of a method for copying and enlargement of thorax images from the cine-size 24 mm. to 80—100 mm. size.

ZUSAMMENFASSUNG

Bericht über ein in Finnland gebautes leicht transportables Gerät für Schirmbildaufnahmen, durch besonders schnelle Montage und bequeme Bedienung gekennzeichnet. Keine Hochspannungskabel werden verwendet. Ein motorloser Patientenaufzug ist mit einer Momentuhr versehen, die die Expositionszeit in Abhängigkeit vom Patientengewicht automatisch angibt. Durch Anwendung einer Spezialkassette für 25 m. Filmlänge wird der Filmverbrauch auf 40 % bei gleichbleibender Bildqualität reduziert. Ferner wird über ein Verfahren zum Kopieren und Vergrössern von Thoraxbildern 24 × 24 mm. zu 80—100 mm. berichtet.

RÉSUMÉ

Rapport sur un appareil de radiophotographie de poids léger, construit en Finlande, aisément transportable, caractérisé par montage rapide, grande maniabilité et emploi facile. Les câbles de haute tension sont éliminés. L'ascenseur mécanique sans moteur pour faire descendre le sujet est muni d'une minuterie pour le déclenchement automatique des temps de pose differents. Cette minuterie fonctionne par rapport au poids du malade. La consommation de film est réduite á 40 % par l'application d'un cassette spéciale pour 25 mètres de film ciné. La qualité des images est aussi bonne que celle obtenue par les autres appareils standards. Enfin un rapport est donné sur une manière de copier et d'agrandir des images du thorax avec cinéfilm 24 mm. à un format de 80—100 mm.

FROM THE GENERAL DEPARTMENT OF RADIUMHEMMET, STOCKHOLM (CHIEF: PROFESSOR KARLIS G. E. BERVEN), AND THE RADIOTHERAPY DEPARTMENT, SÖDERSJUKHUSET, STOCKHOLM (CHIEF: DOCENT HUGO AHLBOM)

THE BEHAVIOUR OF THE THROMBOCYTES DURING AND AFTER LOCAL RADIOTHERAPY[1]

by

Harry Mossberg

During the years 1945 to 1947 I made an investigation about the behaviour of the platelets during and after local radiotherapy. It is published in the supplementum LXVII of this journal and called »Thrombocytopenia following local radiotherapy». I will here give a short abstract of the paper.

The aim of the investigation was to give a contribution to the knowledge of the number of thrombocytes in the circulating blood during and after local radiotherapy, with doses of a size generally used in, for instance, treatment of malignant tumours. I hoped thereby to be able to give information of some value to practical radiotherapy, particularly by inquiring into the risk for thrombocytopenia with haemorrhagic diathesis, that may be involved in such treatment. An attempt is made to define the terms thrombocytopenia and 'local' irradiation.

The impulse and background of the investigation was the observation of two cases of lethal thrombocytopenia and haemorrhagic diathesis following roentgen treatment of the thymus in a case of myastenia gravis, respectively of a carcinoma of the oesophagus.

The literature is reviewed beginning with HEINEKE's findings (1903 and 1904) regarding the deleterious effect of radiation on the cells of the bone marrow, the lymph nodes and the spleen of irradiated mice. The review continues with papers dealing with irradiation effect (experimental and therapeutic) upon the erythrocytes, the white blood cells, the thrombocytes, the clotting mechanism and on the different tests, that have been worked out to study this mechanism, such as the coagulation time, the prothrombin content, the bleeding time, the clot retraction, the calcium content of serum and the capillary resistance test. Different theories concerning the radiation effect on the blood and the cells of the

[1] Submitted for publication, Dec. 1, 1947.

bone marrow are quoted and discussed. Finally the different opinions expressed in the literature as to the existence of an idiosyncrasy to irradiation are mentioned.

A detailed account is given of the laboratory methods used in the investigation: the erythrocyte and leucocyte counts, the reticulocyte count the platelet count, the prothrombin index, the calcium content of serum the coagulation time, the clot retraction, the bleeding time and the capillary resistance test.

The case histories are illustrated by graphs with curves of the thrombocyte and leucocyte values, the given roentgen or radium doses and a picture of the areas of treatment. By this arrangement the effect of irradiation can easily be studied on the graphs. All the data, including the laboratory tests, about the patient are to be found in each case history.

A definite decrease in the platelet count, but no signs of haemorrhagic diathesis, was found in 15 cases. In another group of seven cases a thrombocytopenia appeared. In five other patients there developed a thrombocytopenia or low platelet count associated with signs of haemorrhagic diathesis. Finally two cases of post-irradiation haemorrhagic diathesis with thrombocytopenia and lethal course are described.

The relation between the thrombocytes and the reticulocytes and between the thrombocytes and the white cells after irradiation are recorded. The correlation between the sedimentation test values and the number of thrombocytes is also registered as well as records of the calcium content in the serum after irradiation. Finally an account is given of the prothrombin index, the coagulation time, the bleeding time and the capillary resistance test after irradition, and an attempt is made to distinguish certain types of thrombocyte curves. The importance of repeated thrombocyte counts during and after local radiotherapy in moderate and large doses, especially to certain parts of the body, is pointed out.

SUMMARY

The author gives a short abstract of his paper »Thrombocytopenia following local radiotherapy», Acta Radiologica, Supplementum LXVII, 1947.

ZUSAMMENFASSUNG

Verf. gibt eine kurze Zusammenfassung von seiner Arbeit »Thrombocytopenia following local radiotherapy» (Thrombocytopenia nach lokaler Radiotherapie), Acta Radiologica, Suppl. LXVII, 1947.

RÉSUMÉ

L'auteur donne une analyse abrégée de son ouvrage »Thrombocytopenia following local radiotherapy» (Thrombocytopénie après radiothérapie locale), Acta Radiologica, Suppl. LXVII, 1947.

FROM THE NEUROROENTGENDIAGNOSTIC LABORATORY OF THE UNIVERSITY CLINICS IN LUND, SWEDEN (HEAD: OLLE OLSSON, M. D.)

ROENTGENDIAGNOSTIC POINTS OF VIEW ON SPINAL TUMOURS IN CHILDREN[1]

by

Olle Olsson

Spinal tumours are comparatively infrequent in lower age groups. Early papers in this field give the opposite impression. HORSLEY and GOWERS mentioned in a paper published in 1888 that the spinal tumours in children amounted to 10 per cent in a post mortem material of such tumours. In SCHLESINGER's study (1898) of 151 cases of spinal tumours in a wider sense from a total of 35,000 autopsies the number of children in the cases where age data are given is not inconsiderable. This is due among other things, however, to the fact that tuberculomata, common at that time, are included as well as medulloblastomata metastazising from cerebellum. As a continuation of BRUNS' fundamental work STURSBERG 1908 published a review of the cases of operated spinal tumours in children reported in the literature up to that time. Of 116 cases whose age was known 9 were 15 years old or less. In COLLIN's survey from 1915 of a post mortem material of 40 spinal tumours there were 6 children, and in an operation material of 30 tumours there was one child. FRAZIER (1918) found 5 children among 330 cases of operated spinal tumours. ADSON and OTT (1922) found 2 children among 112 cases. DANDY (1925) in a collection of 36 cases had no less than 7 of less than 20 years of age, 5 of whom he grouped under the heading »glioma and sarcoma». One of these 5 cases is a thoracic tumour engaging the spinal canal, and another a case of a vertebral tumour, however. STOOKEY (1926) had 8 cases of 12 years or less in a material of 165 operated cases; however, two of them were paravertebral tumours which had invaded the vertebral canal. In a great collection from later years ELSBERG (1944) found that among 275 cases 5 only were less than 10 years old and 33 (12 %) 20 years old or less.

The figures given above indicate that the incidence of spinal

[1] Submitted for publication, Sept. 30, 1947.

tumours in children is fairly low. As pointed out by several investigators, high figures based on old post mortem studies may, when comparing them with low figures found in more recent collections of operated cases, give the impression that spinal tumours are often not diagnozed in children and thus never come to be treated. It can in fact not be denied that there may be a discrepancy between the incidence and the diagnosis of spinal tumours in children. However, it was suggested above that this difference also may be due to variations in the classification of various tumours by earlier and more recent investigators.

Types of Spinal Tumour in Children

Hamby studied the incidence of different types of tumour in children. From out of the literature he collected 100 cases of spinal tumour in children of less than 15 years of age. He found that the most frequent type was the glioma, a collective heading for intramedullary tumours, which was found in 23 per cent of the cases. The next frequent type was the sarcoma (18 per cent) and then the lipoma, chloroma, neurinoma, and meningeoma. The two last-mentioned types of tumour were found in 7 and 4 per cent of the cases respectively. These data are strikingly low when compared to conditions in higher age groups, where these types are found in more than half the cases; Rasmussen, Kernohan and Adson (1940) thus found them in 64 per cent of their 557 adult cases.

Gliomata and sarcomata are found all over the youngest age groups, even in infancy. Neurinomata and still more markedly meningeomata do not occur until in the latter part of childhood, whereas dermoids as could be expected preponderate in infancy. Of Stookey's 6 cases of tumour in childhood 3 were intramedullary and 3 extradural, all of the latter being sarcomata (they were however operated upon with good results).

One group of tumours, the *extradural cysts*, have lately attracted great attention. The first detailed description of this type of tumour was made in 1934 by Elsberg, Dyke and Brewer, who reported on 4 cases between 12 and 16 years of age. In a paper published the following year Lehman describes 2 of his own cases and states that he has found 3 cases previously described in the literature. The first of these three cases, taken from Schlesinger's abovementioned work, is uncertain, but Krauss' case from 1908 probably belongs to this type. Some more cases may be found as for instance the one published by Collins and Marks in 1915. Later on several cases have been recorded and surveys performed, all of them incomplete, however. The last

paper on this type of tumour seems to be the one published by Hyndman and Gerber in 1946.

The extradural cysts are of particular interest from many points of view. This holds especially for the skeletal changes accessible for roentgen diagnosis which shall be discussed below. This type of tumour is localized to the thoracic spine, its middle or lower part. Only two cases are described in which the tumour was located elsewhere, *viz.* one in the lumbar spine and the other in the cervical spine (Meredith).

With respect to the origin of extradural cysts it was pointed out by Turnbull (1939): »No satisfactory theory has yet been advanced to explain why these cysts develop and, further, why they occur so constantly in the lower thoracic region». In my opinion their localization seems to justify the assumption that this tumour on the basis of malformation may be related to the embryologically complex area in which according to Holmdahl (1918) the portion of the spinal cord belonging to the trunk-tail-bud joins the central part of the spinal cord germ.

On the basis of two cases certain general and special conditions in spinal tumours in children shall be discussed from the point of view of roentgen diagnosis. Considering the intraspinal localization of the tumours the cases are selected to represent two extremes, the one being extradural and the other intramedullary.

Case Reports

Case No. 1. ♀ E. N. aged 13. Med. Jr. No. 182/42.

Heredity uninteresting. The patient is the 10th of 12 siblings. At the age of 9 she was struck down by a car and remained unconscious for 15 minutes. Normal aftercourse.

In connection with an epidemic of poliomyelitis the patient fell ill at the beginning of September 1941 with a cold in her head, headache and pyrexia. She was kept in bed for a fortnight after which she recovered completely and returned to school. Three days later she began to feel faint in her right leg and was sent by a physician to a hospital for infectious diseases *under the diagnosis poliomyelitis subacuta*. As she was found to have spastic paresis, however, she was sent to the medical and neurological clinic in Lund under the diagnosis Sclerosis disseminata? Tumour?

Examination on admission 8/1 1942. General condition good. Increased lumbar lordosis. Cyanotic feet. Gross power of the dorsal flexors of the foot and the flexors of the lower leg markedly reduced on the right side. Clonus bilaterally on patella and foot. Babinski positive on both sides. Superficial sensibility normal. Deep sensibility abolished in the large toes.

Wasserman test, negative. Sedimentation rate 2/5. Spinal puncture: Pressure initially 90 mm H_2O, free movements. Queckenstedt normal. Liquor clear, negative protein reaction, no increase of cells. Wasserman test in liquor negative.

Roentgen examination of the spine (the author) 24/1 1942: Increased thoracic kyphosis. Slightly below the middle part of the thoracic spine the vertebrae are wedge-shaped, with irregular and fragmented epiphyses. The laminae are thin and also markedly reduced

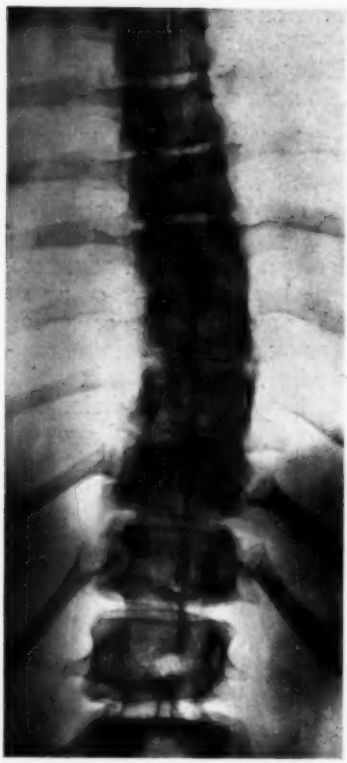


Figure 1. Case No. 1. Extradural cyst. Plain radiogram of the spine showing a marked increase in the interpedicular spaces of Th_9 and Th_{10}.

in height. The interpedicular distance is increased locally: whereas it is 20 mm in Th_8, it is 25 mm in Th_9 and 30 mm in Th_{10}. In Th_{11} the interperdicular distance is again 20 mm (Figs 1 and 2 a).

Roentgen diagnosis: Intraspinal, probably extradural expansive process on a level with Th_9 and Th_{10}.

Myelography with iodine oil shows that the upper limit of the expansive process is situated on a level with the middle part of the vertebra of Th_8 and that the lower limit is on a level with the upper border of Th_{11}.

The patient was transferred to the Surgical Clinic.

Operation: 30/12 1942 (LIEDBERG). The area between Th_9 to Th_{11} is filled by a large cyst with clear contents. It is lying behind dura without any connection with it except in one place where a canal the size of a pinhead runs into the subarachnoidal space. The cyst is 2 cm broad and 5 to 6 cm long.

Postoperative course: Paresis subsides rapidly. After operation gradually increasing kyphosis of the thoracic spine (Fig. 2 b).

Epicrisis: A 13-year-old girl falls ill in connection with an epidemic of poliomyelitis. She has spastic paresis, however, is for some time interpreted as a case of sclerosis disseminata, and finally sent to be diagnozed to the medical and neurological clinic owing to increasing paresis. Spastic paraplegia is then found in the lower extremities and a positive Babinski on both sides. At lumbar puncture the movements are free and Queckenstedt is normal. The superficial sensibility is not changed. Roentgen examination of the spine shows changes indicating an intraspinal process. Its localization and extension together with the long duration of the anamnesis make an extradural process probable. The roentgen findings added to the clinical symptoms result in the probable diagnosis of an extradural cyst which is verified at operation. Increased kyphosis of the thoracic spine is recorded in the aftercourse.

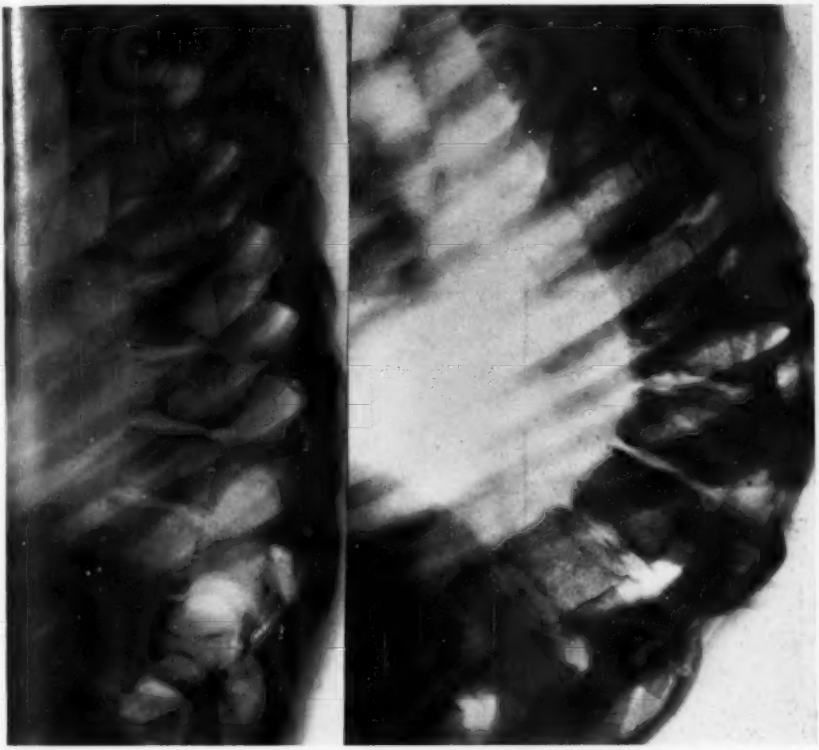


Fig. 2 a. Fig. 2 b.

Fig. 2 a. The corresponding side picture showing kyphosis, compressing of the vertebrae in the thoracic spine and irregular epiphyses. Marked reduction in height of the arches.

Fig. 2 b. 2 years after operation of the extradural cyst. Highly increased kyphosis.

Case No. 2. ♀ E. N. aged 9. Neurosurg. Jr. No. 100/46.

Heredity uninteresting. After having shown catarrhal symptoms for a week the patient, then 4 years old, fell ill in September 1941 with vomiting and pyrexia. Four days later pain in the back set in and weakness in the left foot. She was sent to a hospital for infectious diseases *under the diagnosis poliomyelitis acuta*. Stiffness in the neck, flaccid paresis in the left leg, subfebrile temperature were recorded. Lumbar puncture showed clear liquor with positive protein reactions and slight increase in the number of cells. During the next few days the paresis in the left leg increased and after one month a paresis of the bladder developed.

The patient was transferred to the orthopaedic clinic. The paresis continued to increase to comprise both legs and the abdominal musculature; there was simultaneously

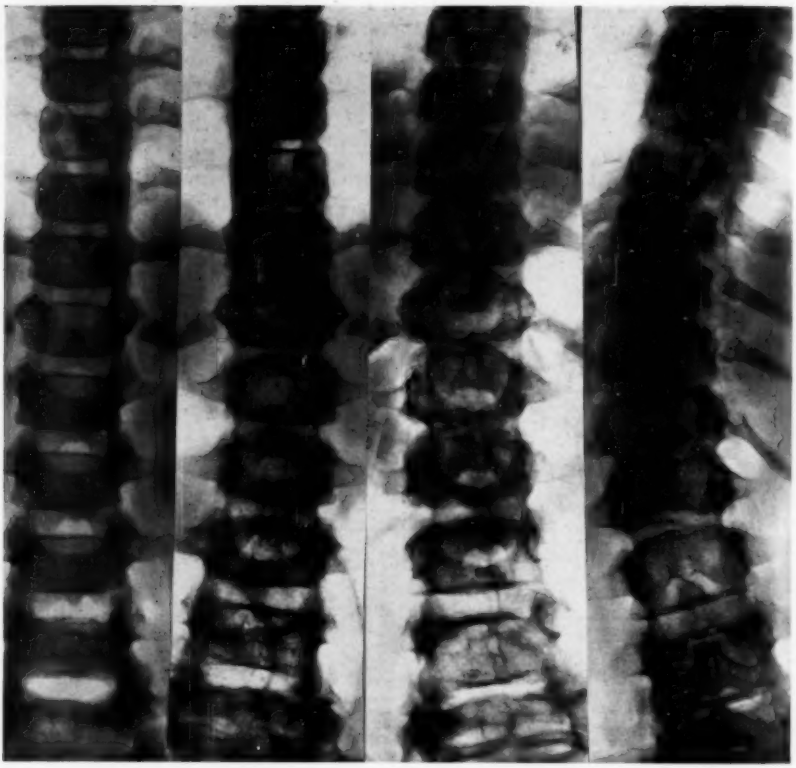


Fig. 3 a. Fig. 3 b. Fig. 3 c. Fig. 3 d.

Fig. 3. Case No. 2. Intramedullary astrocytoma.

a) normal picture in connection with the falling ill.
b) 3 years afterwards. A widening of the interpedicular distances on the transition between the thoracic and the lumbar spine can be registered.
c) and d) further $^1/_2$ year respectively 1 year later show marked widening of the spinal canal.

also paresis of bladder and intestines. Babinski negative. Severe infection of the urinary tract. Lumbar puncture: liquor faintly yellow, free movements, Queckenstedt normal, positive protein reactions, no increase in the number of cells.

Roentgen examination of the spine 30/10 1941: nothing pathological (Fig. 3 a).

The patient was put in a plaster-of-Paris bed, the paresis improved gradually and she was able to walk with support. She was sent home to be treated at home in March 1942. For one and a half year she was treated mainly at home, was able to walk and even learnt to cycle: still incontinentia alvi et urinae, however.

After operation for appendicitis in 1944 the patient got severe pains in the back

Fig. 4 a. Fig. 4 b.

Figure 4. Side picture of case 2.
a) in connection with the falling ill. Normal picture.
b) 4 years afterwards. Increased lumbar lordosis. The posterior surfaces of the vertebrae in the lower thoracal and the upper lumbar spine are scooped out.

and was again admitted to the orthopaedic clinic. Her general condition was then poor, there was considerable infection of the urinary tract, difficulties with the intestinal passage and pronounced flaccid paresis in both legs.

Roentgen examination of the spine 15/9 1944: nothing pathological. (*Re-examination* of the pictures taken discloses a distinct widening of the interpedicular distance on the transition between the thoracic and the lumbar spine) (Fig. 3 b).

The patient was sent home at the express desire of her parents, and was treated at home until April 1945, when she was admitted to another hospital. General condition was at that time very poor, she was extremely emaciated with decubital wounds in the

gluteal region. She had flaccid paresis in the legs and sphincter paresis. Lumbar puncture: liquor bright yellow, positive protein reactions, Queckenstedt: slow rise.

Roentgen examination of the spine: nothing pathological. (*Reexamination* of the pictures reveals a considerable increase of the above-mentioned changes on the transition between thoracic and lumbar spine) (Fig. 3 c).

The patient was transferred to the pediatric clinic in Lund.

From notes taken on admission 17/10 1946: Patient extremely emaciated. Paresis in the whole lower half of the body up to the thoracic plane. Sensibility abolished within this region. Lumbar puncture: liquor very yellow with positive protein reactions. Queckenstedt: very slow movements.

Roentgen examination of the spine 31/10 1946 (the author): lumbar lordosis markedly increased, dextrally convex scoliosis on the transition between thoracic and lumbar spine. From Th_8 downwards to and including L_3 there is a distinct widening of the interpedicular distances most pronounced in the middle part of this region. Whereas the distance in question for Th_7 is 21 mm, it is 24 mm for Th_8 and 26 mm for Th_9. It increases gradually to be 37 mm for Th_{12}, then to decrease again to be 31 mm at L_3 (Fig. 3 d). Within the area of the widening of the interpedicular distances the posterior surfaces of the vertebrae are moreover scooped out (Figs. 4 a and b).

Expansive intraspinal process within the area Th_8 to L_3.

Operation 29/11 1946 (LUNDBERG): Laminectomy at Th_{12} + test excision: the arch of the 12. thoracic vertebra is flattened and the distance between the bases of the arches is markedly increased. The extradural space is almost obliterated and the dural sac is distended and tense. After an incision in the dura and medulla a cyst within thin walls, very long and containing a great amount of clear yellow fluid is found at a depth of 1 mm. The walls of the cyst are lined with a gray jelly-like tumour tissue.

Patho-anatomical diagnosis: Vascular astrocytoma with intratumoral cyst formation.

Epicrisis: A 4-year-old girl falls ill in connection with an epidemic of poliomyelitis with a flaccid paresis in one foot. Lumbar puncture shows positive protein reactions and a slight increase in the number of cells. Queckenstedt is normal. With increasing paresis she is then sent to orthopaedic treatment. After improvement of fairly long duration the paresis increases again. They are all the time flaccid and Babinski is negative. Repeated roentgen examinations are performed, the first negative, but the latter ones distinctly positive although not interpreted as such at the time. By and by a reduction of sensibility is recorded, slow movements at Queckenstedt, and the diagnosis is then settled at the fourth roentgen examination. An extensive expansive intraspinal process is diagnozed and at operation found to be an intramedullary tumour, an astrocytoma. The diagnosis was initially led astray by the continuously flaccid paresis, a negative Babinski, a normal Queckenstedt, and a negative interpretation of the roentgen finding. If the local pressure changes in the spine, distinctly seen at the second roentgen examination, had been observed, it had been possible in spite of the unfavourable clinical constellation to diagnoze the process correctly 2 years before.

General Points of View

Even if spinal tumours in children are fairly infrequent, it is necessary as illustrated most pertinently by the cases reported above to keep this diagnosis in mind. Both these cases have for a longer or shorter period of time been diagnozed erroneously. In both cases the symptoms first appeared in connection with an epidemic of poliomyelitis, and they were thus interpreted as poliomyelitis. A review of the casuistic studies in the literature also indicates that cases of spinal tumour in children are often not diagnozed correctly until in a late stage. In this connection the discrepancy between the incidence data in post mortem and in operation materials mentioned in the introduction should be noted as it may indicate the deficiencies of the clinical diagnosis. This may be due to a number of factors, the most important of which probably being an insufficient knowledge of the occurrence of spinal tumours in children and the difficulty of applying the neurological methods of diagnosis to children. — The present paper is only concerned with one type of diagnosis, the roentgen examination. The roentgen symptomatology in scout films of the vertebral column is here going to be discussed as it seems in many cases in a simple way to be able to indicate the correct diagnosis. Not only the cases here reported but also a survey of the literature suggests that the possibilities of roentgen diagnostics are not sufficiently known in examinations of children. In the two cases here presented the roentgen examination could solve the diagnostic problem immediately in the one case, and in the other after a slight delay, at which time the clinical conditions still were uncertain.

Skeletal Changes in Spinal Tumours

The changes to be observed in the simple scout-roentgenogram of the vertebral column are in the first place due to the increased pressure within the spinal canal. They consist in erosion of one or both pedicles of the vertebra at the level of the tumour, which is the most conspicuous change. There is moreover rarefaction of the laminae and erosion of the body of the vertebra and, particularly in the case of neurinomata, a widening of the intervertebral foramen. Malignant tumours infiltrating directly the skeleton, further have their wellknown roentgenological changes.

The symptoms of increased pressure have long been recognized. In 1933 they were discussed in a wider sense by Camp, Adson and Shugrue on the basis of cases collected in the Mayo clinic. They found skeletal changes in 20 per cent of their cases; in a later paper by Camp this

figure is increased to 50 per cent. The following year these changes were more sharply defined by ELSBERG and DYKE who described the normal picture, drawing attention to the increased interpedicular distances and giving the normal curve for these distances at various levels in the spinal canal *in adults*. They attached special weight to small deviations from the normal measurements and from the normal shape of the pedicles. These authors found a widening of the spinal canal, in the roentgenogram appearing as an increased space between the pedicles, »in 42 % of 67 cases». This widening was particularly striking in tumours below Th_9. The highest percentage of such widening was found in extradural tumours and there especially those located in the mid-thoracic region.

In children increased intraspinal pressure may lead to delayed closing up of zones of ossification. INGRAHAM thus reported cases in which, on a level with the tumour, an incomplete fusion of the laminae of the vertebrae could be registered.

The narrower the spinal canal, the greater are the possibilities of changes due to pressure atrophy developing at a relatively early stage. The spinal canal is widest in the neck and in the lumbar region where mobility is greatest. It is narrowest within the thoracic region (with a minimum between Th_6 and Th_9) where according to AEBY the transverse section of the vertebral canal amounts to 230 mm², whereas the corresponding figure for the spine of the neck is 380 mm² and for the lumbar spine 320 mm². In this connection it should be noted that ELSBERG and DYKE's normal curve for the interpedicular spaces is lowest between Th_4 and Th_8.

A correct diagnosis is facilitated by the fact that spinal tumours are most frequent within the thoracic spine. In RASMUSSEN, KERNOHAN, and ADSON's collection of 557 cases of intraspinal tumours, 54 per cent were located to the thoracic spine. Within the various subgroups, too, there was an almost constant predominance of the thoracic region, often very marked. In the above-mentioned study of spinal tumours in children by HAMBY there is also a marked predominance of tumours located to the thoracic region.

Besides the changes just discussed which are directly related to the increased pressure another type of changes has been recorded in spinal tumours in children. When describing his two cases of extradural cysts LEHMAN stresses that »the most striking single addition to the picture is offered by the curious lesions of the vertebral bodies presented by case one». In this case he found a more or less increased thoracic scoliosis with destruction of the upper and lower anterior margins of two thoracic vertebrae on a level with the tumour. He interprets this changes as an »epiphysitis». In his second case, too, similar changes

were found at biopsy after operation. A survey of other roentgen examined cases in the literature shows that the change belongs to the picture of an extradural cyst located to the thoracic spine. Good, Adson, and Abbot hold that it is pathognomonic for this type of tumour. This need not be correct; as early as in 1925 Feiling noted briefly a similar change in connection with an intramedullary tumour.

The change corresponds largely with juvenile kyphosis both as regards the age of the patients and the appearance of the roentgenological changes.

Explanation of the Kyphosis Occurring in Cases of Intraspinal Tumour in the Thoracic Spine

The similarity between this type of kyphosis and juvenile kyphosis suggests that the latter type also be discussed in connection with the one occurring in cases of extradural cysts. As yet the attempts at explaining these very similar types of kyphosis have only taken into account the carrying elements of the spine, that is, the line of vertebral bodies with the intervertebral disks between them. Scheuermann thus maintains that kyphosis is caused by »die Knorpelschicht an den Corpora in die Spongiosa hineingedrückt wird». Schmorl seeks the cause of kyphosis in the intervertebral disk which shows developmental disturbances. A theory directly referring to kyphosis in extradural cysts was proposed by Cloward and Bucy 1937. They too sought the explanation in the vertebral bodies. They suggest that, when the pressure in the cyst rises above the liquor pressure normal at the level in question, the point may be reached where the posterior central vein of the vertebral body is actually occluded and severe venous stasis results. This causes a destruction of the vertebral bodies with an ensuing compression of them. Cloward and Bucy explain all cases of kyphosis in lower age groups by assuming a venous congestion »of unknown etiology».

In my opinion another explanation seems more probable. An increase in the thoracic kyphosis may be due either to

1. *a change in the carrying part of the spine,* thus the pillar of vertebral bodies and intervertebral disks, or to

2. *a change in the staying part of the spine,* the groove formed by the arches and ligaments.

Obviously the two factors can be combined.

Only the former factor has been considered by previous authors. There are, however, very good reasons to assume that the cause is to be found — solely, or also — in factor 2. Some mechanical data as to the thoracic spine may here be of interest.

The thoracic spine is the stiffest part of the spine. Fick thus

mentions that even in contortionists at extreme movements the thoracic part of the spine remains relatively unchanged. This is due partly to the comparatively low intervertebral disks, partly and predominantly to the movement inhibiting factors in the arches of the thoracic spine. These inhibiting factors are the posterior longitudinal ligament, the joint capsules in the intervertebral joints, and the ligaments between arches and spinal processes. A weakening of this staying apparatus must lead to an increase in thoracic kyphosis. This is favoured by the fact that the thoracic spine normally is concave and that the strain exerted on it tends to increase the curvature, and furthermore by the circumstance that from a normal position the thoracic spine is most easily bent forwards in contradistinction to the neck and the lumbar spine, which are easiest bent backwards. The fact that, according to MACALISTER, the weakest part of the spine in relation to strain is found in the thoracic region (at Th_5), may also play a rôle in this connection.

In cases of extradural cysts the necessary prerequisites for a weakening of the *staying* power of the thoracic spine are present. By pressure on the walls of the spinal canal the cyst causes a complete atrophy of the posterior longitudinal ligament. The arches atrophy very markedly both in breadth and height. This atrophy probably also engages the ligamenta flava. Owing to the comparatively low mobility of the thoracic spine and to the arrangement of the back musculature the staying by ligaments within the thoracic spine cannot be replaced by muscular support. The deficient staying leads to an increase in the pressure exerted on the vertebral bodies then — as extradural cysts belong to the childhood — in a stage of development and sensitive to reshaping.

When the cyst has been removed with extensive laminectomy required by the considerable size of the cyst in most cases the support of the spine has decreased further still, and the kyphosis thus has a chance of continuing to develop. Such was in fact the case with the patient described in our first case (see above Figs. 2 a and b). At operation the spinal processes of Th_{8-11} and the arches of Th_{9-11} were removed. A kyphosis diagnozed already before operation increased in immediate connection to the operation and subsequently caused the patient considerable trouble in the form of insufficiency of the back. In LEHMAN's cases, too, the kyphosis increased after extirpation of the cyst. In his first case where changes of the vertebral bodies were present before operation but only a slight kyphosis, control examination 15 weeks after operation showed that a kyphosis accompanied by more pronounced vertebral changes than those found before operation, had developed. In his second case no kyphosis was observed before ope a-

tion. However, after operation a gradually increasing, pronounced kyphosis with strong compression of the vertebrae was found.

According to the explanation here suggested such a development is not surprising. In a wider connection this might be worth remembering in conditions accompanied by increased pressure on and compression of vertebral bodies and intervertebral disks.

Incidence of Skeletal Changes in Cases of Spinal Tumour in Children

With respect to the above-mentioned changes in the spine due to the pressure of tumours LINDGREN pointed out that they are only elicited by slowly growing tumours which moreover in order to erode arches and vertebral bodies must have reached a considerable size. Thus, if on the one hand a tumour, slowly developing during a long period of time, has great possibilities of eliciting atrophy of the arches, the changes caused by it are on the other hand furthered by a skeleton in an evolutional stage sensitive to reshaping. Both these factors are present in the growing individual. In children the chances of detecting spinal tumours by demonstrating local changes by pressure in the spine should thus be particularly good. The data available in the literature do not permit of any conclusions as to the incidence of such changes in children. There is probably no doubt, however, that they are very frequent. This opinion is not based on the fact that cases recorded in the literature are operated upon in cause of such changes being discovered. On the contrary the majority of them belongs to the time before the diagnostic importance of these changes was known. It is based on the number of cases with such changes found on re-examining the roentgenograms after operation.

All these published cases of extradural cysts in children in which the roentgenograms have been available show increased interpedicular space if regard is taken to the figure normal for their age. In a great number of these cases even essential changes have been overlooked initially and not been recorded until at a re-examination.

NISENSON and PATERSON reported 3 cases of ependymoma in which re-examination showed increased interpedicular spaces. In EHNI and LOVE's collection of intraspinal lipomata 7 of 12 roentgen examined patients showed spinal changes. All the three cases of less than 20 years of age in their collection showed such changes. In 1938 INGRAHAM published 16 cases of spinal tumour in children. In 11 of these there are brief notes of the results of roentgen examination of the spine; positive changes were recorded in 5 cases. The remaining 6 cases are labelled normal, which seems highly doubtful, however, considering the

operation findings. On the whole a study of the literature in this field clearly shows that roentgen diagnostics are not sufficiently utilized and that pathological changes have been overlooked quite frequently. For children as well as for adults it holds that extradural tumours give the most extensive and earliest changes. This is shown also by the extradural cysts as in our first case. Roentgen examination may, however, be helpful also for diagnozing their antipode, the intramedullary tumours, and this especially in growing patient. Our second case is particularly instructive in this respect. The roentgen examination of the spine here showed normal conditions 6 weeks after the onset of the disease. The examination was not repeated until three years later when the findings were positive. The spinal changes probably set in very late in cases of intramedullary tumours. As the symptomatology and the clinical diagnostic often cause these cases to be examined in a very late stage, a simple roentgen examination of the spine should never be omitted. If the findings are negative but the clinical picture remains uncertain, the examination should be repeated at not too long intervals.

SUMMARY

The incidence and type of spinal tumours in children are discussed. The appearance and incidence of changes that can be observed in plain radiograms of the spine in such cases are considered. The author tries to give an explanation of the kyphosis and the changes of the vertebral bodies developing in the thoracic spine in certain spinal tumours in children.

ZUSAMMENFASSUNG

Die Häufigkeit und der Typus von Wirbelsäulentumoren bei Kindern werden besprochen. Aussehen und Häufigkeit der bei solchen Fällen in einfachen Röntgenaufnahmen der Wirbelsäule zu beobachtenden Veränderungen werden beachtet. Verf. versucht die bei gewissen Rückenmarkstumoren bei Kindern in der Brustwirbelsäule zur Entwicklung kommende Kyphose und die Veränderungen der Wirbelkörper zu erklären.

RÉSUMÉ

Discussion de la fréquence et du type des tumeurs spinales chez les enfants. L'auteur s'attache à l'aspect et à la fréquence des altérations qui peuvent, dans ces cas-là, être observées sur de simples radiographies de la colonne vertébrale. Il essaye de donner une explication de la kyphose et des modifications des corps vertébraux qui se développent à la colonne dorsale dans certaines tumeurs du rachis des enfants.

REFERENCES

Adson a. Ott: Arch. Neurol. a. Psychiat. *8*, 1922, 520.
Aeby cit. Fick.
Camp: Radiology *22*, 1934, 295.

CAMP, ADSON a. SHUGRUE: Am. J. Canc. *17*, 1933, 348.
CLOWARD: Am. J. Surg. *105*, 1937, 401.
CLOWARD a. BUCY: Am. J. Roentgenol. *38*, 1937, 681.
COLLINS: Med. Record 62, *1902*, 882.
COLLINS a. MARKS: Am. J. M. Sc. *149*, 1915, 103.
DANDY: Am. J. Surg. *81*, 1925, 223.
EHNI a. LOVE: Arch. Neurol. a. Psychiat. *53*, 1945, 1.
ELSBERG: Surg. Dis. of the Spinal Cord., Hoeber, 1944.
ELSBERG a. DYKE: Bull. Neurol. Inst. New York, *3*, 1934, 354.
ELSBERG, DYKE a. BREWER: Bull. Neurol. Inst. New York, *3*, 1934, 395.
FEILING: Lancet *1*, 1925, 957.
FICK: Handb. d. Anat. des Menschen, Jena, 1911.
FRAZIER cit. HAMBY.
GOOD, ADSON a. ABBOT: Am. J. Roentgenol. *52*, 1944, 53.
GOWERS a. HORSLEY: Tr. Med.-Chir. *71*, 1888, 377.
HAMBY: J. Nerv. & Ment. Dis. *81*, 1935, 24.
HOLMDAHL: Utvecklingen av den kaudala delen av ryggmärgen hos människan. Lund, 1918.
HYNDMAN a. GERBER: J. Neurosurg. *3*, 1946, 474.
INGRAHAM: Am. J. Surg. *39*, 1938, 342.
KRAUSS: Brain, *30*, 1907, 533.
LEHMAN: Am. J. Surg. *28*, 1935, 307.
LINDGREN: Nervenarzt *10*, 1937, 240.
MACALISTER cit. FICK.
MEREDITH: Virginia M. Monthly *67*, 1940, 675.
NISENSON a. PATERSON: J. Pediat. *27*, 1945. 315.
RASMUSSEN, KERNOHAN a. ADSON: Am. J. Surg. *111*, 1940, 513.
SCHEUERMANN: Acta orthop. Scandinav. *5*, 1934, 161.
SCHLESINGER: Rückenmarks- und Wirbeltumoren, Jena, 1898.
SCHMORL: Fortschr. a. d. Geb. d. Röntgenstrahlen *41*, 1930, 359.
STOOKEY: Am. J. Dis. Child. *36*, 1928, 1184.
STURSBERG: Zentralbl. f. d. Grenzgeb. d. Med. u. Chir. *11*, 1908, 91.
TURNBULL: J. Canad. Med. Ass. *41*, 1939, 250.

FROM THE DEPARTMENT OF ROENTGENOLOGY, CAROLINE HOSPITAL, STOCKHOLM, SWEDEN (CHIEF: PROFESSOR ÅKE ÅKERLUND)

MEDIASTINAL ABSCESS DIAGNOSED BY ROENTGEN[1]

(Puncture under fluoroscopic control and injection of a water soluble contrast medium)

by

Sven Roland Kjellberg

The roentgenological diagnosis of mediastinal processes is often difficult. Sometimes a mediastinal puncture and injection of contrast medium can solve the problem — as can be seen in the following case. Such a puncture is in most cases difficult to carry out and is somewhat hazardous. It is considered that the risk is reduced by using a very fine needle. The procedure is much easier if performed under fluoroscopic control. Thick pus cannot be aspirated through such a fine needle, but the contrast medium can be readily injected. With the aid of this injected contrast medium very valuable information can be obtained regarding the extent of an abscess.

A 25-year-old farm labourer became acutely ill on March 26th 1946 with »influenza». He had always been well except for pneumonia in 1943. In spite of the »influenza» he kept on working as usual but visited a doctor on April 1st because he coughed up some blood.

Nothing noteworthy could be found on investigation except for a bloodstained nasal discharge with clots on the posterior pharyngeal wall. He had a low fever, large chronically infected tonsils and his B. S. R. was 52.

However, his chest roentgen, when compared with that taken three years before (Fig. 1), showed an increase in the width of the upper part of the mediastinal shadow (Fig. 2 and 2 a). No changes, other than a slight enlargement of the left hilus, could be observed in the lung fields.

The patient's condition improved and after 14 days he was well again. About a week later, he had a tonsillectomy without any complications.

He worked all the following summer and felt completely well until the middle of September when he began to feel tired, had epigastric discomfort and pain in the lumbar region.

He visited the doctor who found that the mediastinal shadow was wider, and the B. S. R. raised. Nothing else could be found. It was now clear that a mediastinal process was present and the patient was sent to the C. H. for further investigation. On

[1] Submitted for publication, Sept. 25, 1947.

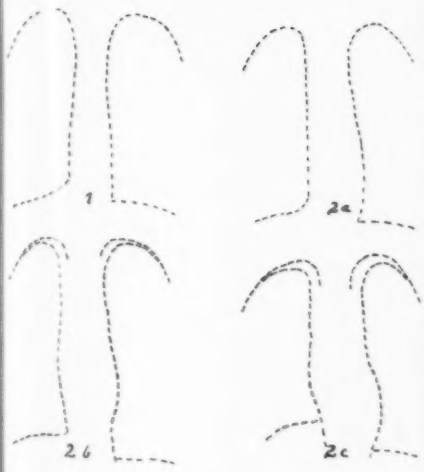


Fig. 2.

Fig. 1. The width of the posterior mediastinum three years before the onset of illness.
Fig. 2 a—c. The widening of the posterior mediastinum on April 1st, October 9th and December 5th.

Fig. 3. Fig. 4. Fig. 5.

Fig. 3 and 4. The posterior mediastinum is wide and the trachea and oesophagus are displaced forwards.
Fig. 5. Marked increase in the prevertebral soft tissue shadow of the neck.

Fig. 6. Fig. 7.

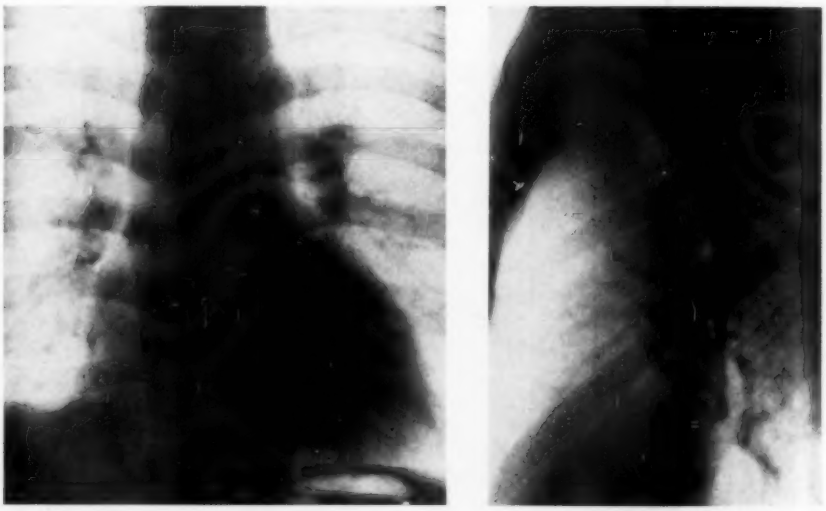


Fig. 8 a. Fig. 8 b.

Fig. 6. A small pointed posterior projection of the oesophagus at the lower border of C. 7.
Fig. 7. Contrast medium injected into the abscess cavity.
Fig. 8. The prevertebral thickening has considerably subsided and the changes in the oesophagus have disappeared.

admission, he was afebrile, had a B. S. R. of 41, and had some small lymph nodes at the angle of the right jaw and in the right supraclavicular region. Biopsy of one of these nodes showed only slight lymphadenitis with no signs of a specific or malignant process. Roentgen picture showed widening of the posterior mediastinum right down to the diaphragm, (Fig. 2 b and 3) and was most marked in the upper part. It had increased considerably since the investigation of the previous month. During his stay in the C. H., his temperature and B. S. R. gradually began to rise. In the beginning of December, his B. S. R. was 110 and temperature 38—38.5° C. At this time, patient developed a pain in the right side of the thorax. No friction rub, rales or other signs of pulmonary disease could be found. However, he was started on penicillin.

New radiographs on December 5th showed that the process had progressed considerably. The posterior mediastinum was much wider, and the trachea and oesophagus were displaced forwards. See Fig. 2 c and 4.

Now it could be seen, just as before, but possibly to a somewhat greater degree, that there was a marked increase in the prevertebral soft tissue shadow in the neck — fig. 5.

Roentgen investigation of the oesophagus showed a small pointed posterior projection near its entrance at the level of the lower border of C. 7. — see fig. 6. The mucous membrane in this region was distinctly altered — being irregular and granular. A small area of decalcification could be seen in the anterior part of the body of C. 7. No other bone changes could be observed. The intervertebral disks were intact.

In spite of the unusual course of the illness, a mediastinal abscess was now suspected.

In order to verify the diagnosis, a puncture of the superior mediastinum was carried out under fluoroscopic control, on December 6th, with a fine needle.

The patient was given a little barium to swallow in order to simplify the localization. The needle was inserted into the right supraclavicular fossa in a downwards and medial direction. The needle went in easily until it came to the abscess wall. Here it met with a firm resistance, probably due to the induration about the abscess.

After the wall of the abscess was penetrated, a small amount of contrast medium was injected and then a little of the contents was aspirated. This had probably been thick and greyish with no special odour.

In order to study the full extent of the abscess cavity, a large amount of contrast material had to be injected. This was accomplished by removing a similar amount of pus.

Only a small amount of contrast medium was injected at a time, to avoid an increase in the intra cavitary pressure. The mediastinum was radiographed after about 15 ccs of contrast medium had been injected. It could then be seen that there was an abscess cavity 10 cms long and 2—3 cms wide in the upper and middle part of the mediastinum — see fig. 7. As the diagnosis was now clear, penicillin was injected into the abscess cavity after further aspiration of its contents.

Fig. 9 a.

Fig. 9 b.

Fig. 10.

As a result of this investigation, the patient was transferred to the surgical department for eventual operation. This was delayed because of the technical difficulties involved, and because tuberculosis could not be definitely excluded. Instead, aspiration of the abscess was again carried out with the same result as in the roentgen department. The pus was sterile on both occasions. No bacteria could be seen in the smears, and the cultures were negative.

The patient received large amounts of penicillin during his stay in the surgical ward and his condition steadily improved. Coincidental with his subjective improvement, the mediastinal abscess decreased in size and on a roentgenogram on March 6th 1947, fig. 8, the mediastinum appeared the same as in the beginning on April 1st 1946.

The changes in the oesophagus had entirely disappeared, and the prevertebral thickening was considerably reduced, fig. 9. The change in the vertebral body (C. 7) could still be seen, but it was now well demarcated, fig. 10.

Briefly, it can be seen that the roentgenogram of April 1st 1946 showed a slight widening of the superior mediastinum especially in comparison with that taken three years earlier.

On further roentgen control, the gradual progress of the mediastinal process could be observed. As the suspicion arose that we were dealing with a mediastinal abscess, even the neck was radiographed. This showed that the prevertebral soft tissues were distinctly wider than normal and that there were changes in the upper part of the oesophagus suggestive of a fish bone injury. In the anterior part of the body of C. 7. could be seen a superficial decalcification which was probably secondary to the soft tissue process.

Mediastinal puncture and injection of contrast medium demonstrated a large abscess in the posterior mediastinum.

The process receded under penicillin therapy. The diminution in the abscess cavity and the complete disappearance of oesophageal changes were followed with the roentgen examination.

It is difficult to arrive at a definite conclusion regarding the etiology of the abscess. The insidious course, the positive Mantoux, and the sterile pus would suggest tuberculosis. However, the very high B. S. R., the swinging temperature at the end of 1946, and the good effect of penicillin therapy would indicate that the process was of septic nature.

The changes in the oesophagus and vertebral body could be secondary but the oesophageal changes looked more like a primary oesophageal lesion — possibly due to a fish bone. It is true that the patient had never noted a fish bone caught in his throat, but the oesophageal and vertebral body changes look like a foreign body injury.

The haemoptysis which the patient had at the beginning of his illness can be entirely attributed to his bloodstained nasal discharge and clots on the posterior pharyngeal wall. The negative lung findings tend to confirm that.

The patient's »influenza» can hardly be considered as the cause of the mediastinal abscess. A distinct widening of the mediastinal shadow could be seen as early as the fourth day of his illness. A mediastinal process with such a chronic low grade course could hardly have caused such a mediastinal widening in only four days.

Undoubtedly, this process began earlier.

SUMMARY

The differential diagnosis of mediastinal processes is often difficult. A solution may sometimes be reached by mediastinal puncture under screen control and injection of a water soluble contrast medium. This can be seen in a case of mediastinal abscess which has been described. The etiology of this abscess has not been entirely clarified.

ZUSAMMENFASSUNG

Die Differentialdiagnose der mediastinalen Prozesse ist oft schwer. Manchmal kann eine Mediastinalpunktion unter Durchleuchtungskontrolle mit Einspritzen von Kontrastflüssigkeit zur Klärung beitragen, wie es aus dem hier wiedergegebenen Falle hervorgeht, dessen Ätiologie jedoch nicht völlig klargelegt werden konnte.

RÉSUMÉ

Le diagnostic différentiel des processus pathologiques du médiastin est souvent difficile. Parfois une ponction médiastinale, sous contrôle radioscopique, avec injection de liquide de contraste, peut contribuer à la solution du problème, ce qui ressort du cas relaté ici, bien que son étiologie n'ait pas pu être complètement élucidée.

FROM THE DEPARTMENT OF DIAGNOSTIC ROENTGENOLOGY OF THE CAROLINE HOSPITAL, STOCKHOLM, SWEDEN (CHIEF: PROFESSOR Å. ÅKERLUND)

A PREVIOUSLY UNREPORTED SIGN OF FOREIGN BODIES IN THE TRACHEA[1]

by

Sven Roland Kjellberg

If the classical signs of bronchostenosis are found on roentgen examination of a previously healthy child, there is good reason to suspect a foreign body, even if it is not directly demonstrable in the radiographs. It is generally necessary that this foreign body descends into a bronchus for the classical signs to appear.

If a non-radio-opaque foreign body is present in the trachea, and the usual signs of bronchostenosis are lacking or are uncertain or insignificant, the roentgenological diagnosis then becomes distinctly more difficult. In such cases the following sign, which depends on the softness of the tracheal cartilaginous rings in small children, can be of great help. If for some reason or other, a foreign body is lodged in the trachea, *on inspiration* the trachea below foreign body becomes narrower because of the resulting negative pressure, (see fig. 1), and the air passages above the foreign body become considerably dilated-especially the larynx and pharynx. *On expiration* the lower portion of the trachea on the contrary either widens sligthly or returns to normal width; while above the foreign body, the air passages become of normal, or possibly of somewhat narrower than normal width. (see fig. 2). It is, therefore, very important to take films of the whole trachea and proximal air passages in inspiration and expiration.

In inspiration films, even if the foreign body is fairly small or thin and flat, the transition from the collapsed to the proximal widened part of the air passages can lead one to suspect a small shadow of soft tissue density which corresponds to the foreign body. This can be observed in fig. 1.

[1] Submitted for publication, Sept. 25, 1947.

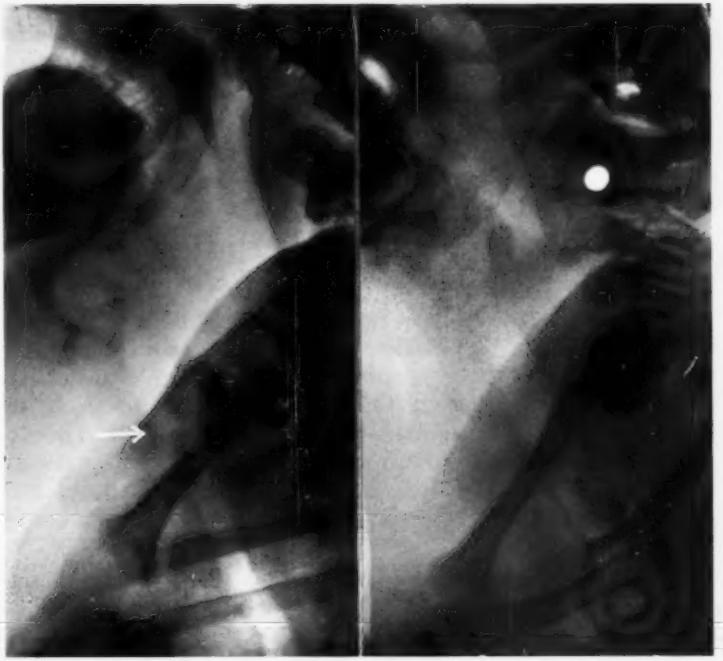


Fig. 1. Fig. 2.

Fig. 3.

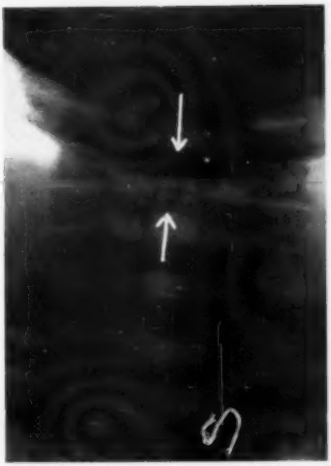


Fig. 4.

Fig. 1. Inspiration. Collapse of the trachea below and widening of the air passage above the foreign body.

Fig. 2. Expiration. Normal sized air passage or possibly slight widening of the trachea.

Fig. 3. Flat foreign body (piece of bark).

Fig. 4. Antero-posterior film with flat foreign body in the trachea just below the vocal cords.

The films reproduced here are those of a one-year-old girl. According to the mother the child was playing alone in an adjoining room, when suddenly she began to cough and choke. The mother noted that the girl had difficulty in breathing. She brought her to the Ear, Nose and Throat Department of the Caroline Hospital, where, however, no foreign body could be observed on laryngoscopy. She was then sent to the Roentgen Department. Here the foreign body described above was demonstrated. It was removed without difficulty with the aid of a bronchoscope. The extracted foreign body was a thin, flat piece of bark and it's size and appearance can be noted in fig. 3. It was situated just below the vocal cords.

Flat foreign bodies in the trachea, as opposed to those in the esophagus, usually lie in the sagittal plane, due to the anatomical relationships, namely rima glottidis and pars membranacea trachea. In order to visualize such a thin foreign body a properly exposed antero-posterior film is essential. In fig. 4, the sagittally situated flat foreign body is seen immediately under the vocal cords. The trachea shows a slight decrease in lumen at the level of the thin, knife-like foreign body.

SUMMARY

The author describes a previously unreported sign of foreign bodies in the trachea in children; namely, *inspiratory* collapse below and simultaneous widening of the air passages above the foreign body. These changes disappear on *expiration*.

ZUSAMMENFASSUNG

Verf. beschreibt ein bisher nicht beachtetes Symptom bei Fremdkörpern in der Trachea bei Kindern, nämlich inspiratorisches Zusammensinken der Luftwege unterhalb und gleichzeitige Ausdehnung derselben oberhalb des Fremdkörpers, Veränderungen, die bei der Ausatmung zurückgehen.

RÉSUMÉ

L'auteur décrit un indice jusqu'ici passé inaperçu, de la présence des corps étrangers dans la trachée des enfants, consistant à l'inspiration, en un collapsus des voies respiratoires au-dessous du corps étranger avec une dilatation simultanée au-dessus, ces deux phénomènes disparaissant à l'expiration.

FROM THE DEPARTMENT OF ROENTGEN DIAGNOSTICS, KAROLINSKA SJUKHUSET, STOCKHOLM, SWEDEN (CHIEF: PROF. ÅKE ÅKERLUND)

WIDENING OF THE ROOT DEFECT IN LUMBAR MYELOGRAM BY ABRODIL[1]

by

Rasmus Stenström, Helsingfors.

As is generally known operators have believed that a swelling of nerve roots has been formed at herniation of the disc. One can ask oneself, whether it really always is a swelling and not only a widening in consequence of a flattening on account of the herniation of the disc. Viewed against the background of LINDBLOM's observations on pictures from subjects (1, 2), where herniation of the disc has caused nerve compressions, the later interpretation, viz. the flattening as the cause of the widening of the root defect, seems more plausible than the swelling. The material consists of 158 myelograms by abrodil (3) from patients suffering from low back or irradiating pains of sciatic type. The material embraces the period from May 1944 to March 1947. The duration of symptoms has varied between two days and 26 years. The material has been examined with the intention of ascertaining, how often one sees a widening of the root defect in roots coming out. Thereupon roentgen findings and operative findings have been compared in order thereby to obtain an idea of the anatomical analogy to the widening of the root defect and thus also an expression for the value of this roentgen symptom.

In 42 = 26.6 per cent of the cases there was a distinct widening of the root defect. (Fig. 2 and 3.) The remaining 73.4 per cent are cases, where the quality of the picture does not admit of a positive judgment of the root defect, and where the defects are very large, whereby the root defect is more or less blurred, and further all the median herniations of the disc as well as, of course, the negative finds of myelography. (Fig. 1.)

Of the 42 cases 31 have been operated. There were 21 herniations and 9 protrusions of the disc. In the only negative case the operator

[1] Submitted for publication, Aug. 26, 1947.

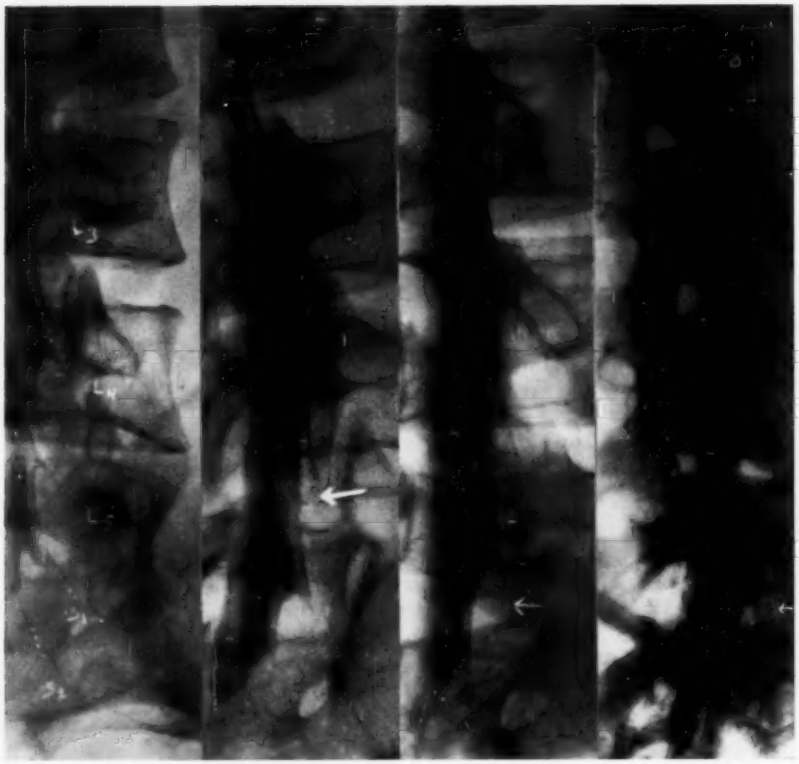


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

Fig. 1. Myelogram without pathological changes.

Figs. 2—3. Widened root defect of 5. the lumbar respectively 1. the sacral nerve with lacking contrast filling of the root pocket.

Fig. 4. Compression over 5. the lumbar nerve with widening of the defect of 1. the sacral nerve distally around the compression.

says: »not herniation of the disc, to be incised, resulting in hard bleeding, fishing without getting anything.» It can be that there has been an overlook on the part of the operator. At control three months later the following has been noted: »No improvement worth mentioning. Lasègue still + 45°.»

In 11 of the cases operated the nerve root is said to be swollen, thickened or oedematous. In another case the nerve root is said to be

»slightly altered». So called rootswelling has consequently been found in only amply 1/3 of the operated cases. The low degree of conformity could probably be explained by the operator having spontaneously given the aspect of the nerve root but slight consideration. The number of so called rootswellings mentioned in the reports of operations is namely increasing from year to year. Such swellings are mentioned in two distinct cases in 1944 and in 1945, in addition to one case with »slight changes», of a total of 14 operated ones, and in 1946 four cases of 11 operated. In January—March 1947 finally, when in the roentgen report particular attention was paid to the widening, so called root swelling was mentioned in five of six cases operated.

In only one case there is a note about the nerve root looking normal, with the additional information of its being dorsally displaced. The patient is a man in military service, with two months' history of the illness. On account of the brevity of the history the roentgen find may best be explained by the flattening with a widening of the root defect caused by the dorsal displacement and the stretching over the herniation of the disc. This opinion is supported by another case with a »swollen» and laterally displaced root, where the operator mentions that the nerve root is »tautly stretched».

The fact that the root defect peripherally around the place of compression seems to be widened speaks in favour of the swelling of the nerve roots in certain cases really being in question. (Fig. 4.)

As a final opinion it can be said, that the roentgen symptom »widened root defect» probably merits greater attention than it has received so far both from the radiologist's and the operator's side. In order to be able to answer the question proposed concerning the cause of the widening of the root defect it is necessary that the operators themselves in the future keep their mind on how to interpret this symptom, that is to say to look and see, whether the roots really are swollen, or if the swelling means a flattening over the herniation of the disc. Under all circumstances the widened root defect seems to be a valuable roentgenologic symptom of herniation of the disc.

SUMMARY

The writer has examined 158 myelograms by abrodil and ascertained the widening of the root defect in 42 cases. So called root swelling is mentioned in 11 of the 31 operated cases, viz. in amply 1/3 of the cases. The rather low average according to the writer probably, at least partly, depends on the operators initially not having paid sufficient attention to the aspect of the nerve root. In order to find out, whether the widening of the root defect depends only on flattening or on real swelling of the nerve root, a continued cooperation between the operator and the radiologist will be necessary.

ZUSAMMENFASSUNG

Verf. hat 158 Abrodil-Myelogramme durchgesehen und bei 42 Fällen eine Verbreiterung des Wurzeldefekts festgestellt. Sog. Wurzelschwellung ist bei 11 der 31 operierten Fälle erwähnt, d. h. bei reichlich 1/3 der Fälle. Diese ziemlich niedrige Durchschnittszahl dürfte nach Verf. wenigstens zum Teil dadurch bedingt sein, dass die Operateure im Anfang dem Aussehen der Nervenwurzel nicht genügende Aufmerksamkeit schenkten. Zur endgültigen Klarlegung der Frage, ob die Verbreiterung des Wurzeldefekts nur durch Abflachung oder durch wirkliche Schwellung der Nervenwurzel bedingt ist, ist weitere Zusammenarbeit von Operateuren und Röntgenologen erforderlich.

RÉSUMÉ

L'auteur a examiné 158 myélographies à l'Abrodil et constaté un élargissement de la lacune radiculaire dans 42 cas. La tuméfaction radiculaire, comme on l'appelle, a été notée dans 11 cas sur 31 qui furent opérés, c'est-à-dire largement dans un tiers de ceux-ci. Cette moyenne très faible doit, selon l'auteur, s'expliquer au moins partiellement par le fait que les opérateurs, au début, n'attachaient pas une importance suffisante à l'aspect de la racine nerveuse. Pour tirer définitivement au clair la question de savoir si l'élargissement de la lacune radiculaire dépend d'un simple aplatissement ou au contraire d'une vraie tuméfaction de la racine nerveuse, une continuation de la collaboration entre opérateur et radiologiste est exigée.

BIBLIOGRAPHY

1. Lindblom, K.: Acta Radiol. 22: 711. 1941.
2. —, Acta Radiol. 25: 195. 1944.
3. —, Acta Radiol. 31: 1. 1946.

FROM THE SAMARITAN CHILDREN'S HOSPITAL, STOCKHOLM, SWEDEN

WATER SOLUBLE CONTRAST MEDIUM FOR THE PRECISE ROENTGENOLOGICAL DIAGNOSIS OF CYSTS OF THE COMMON BILE DUCT[1]

by

Sven Roland Kjellberg

Congenital common duct cysts are very rare and the clinical as well as the roentgenological diagnosis of these cysts is very difficult.

The signs of common duct cysts described in the roentgenological literature are the cyst's shadow and the eventual calcification of its wall, as well as the compression effects which the cyst produces on neighbouring organs (DI NATALE, WRIGHT, SMITH, THOMAS and others). These signs can be produced by other changes in the biliary tract such as liver cysts, or an enlarged gall bladder.

The precise roentgen diagnosis will sometimes be possible of a water soluble contrast medium is injected directly into the cyst. The risk involved in such an injection is slight or non-existant if a very fine puncture needle is used. This is illustrated in the following case.

A seven-year-old boy was admitted at the end of 1946 to the Samaritan Children's Hospital for the investigation of an accidentally discovered palpable resistance below the liver edge. The tumor could not be distinctly outlined and only a fullness could be felt in this region. The patient felt perfectly well. On *roentgen examination* of the abdomen a fairly large soft tissue mass was found which was continuous with the liver outline. No filling of the gall bladder was noted on cholecystography, indicating gall bladder disease. An operation was suggested but was postponed because the patient was entirely free of complaints.

During his stay at home, however, his general condition gradually deteriorated and at the time of his next admission, in April, 1947, his state was considerably altered. Now a large, partly fairly soft resistance could be palpated below the right costal margin and it extended down to the level of the umbilicus. The patient was subicteric.

Roentgenological examination disclosed a large soft tissue mass, continuous with the liver. It had a sharply outlined border, and displaced the colon and small bowel downwards.

[1] Submitted for publication, Sept. 25, 1947.

This soft tissue shadow had increased considerably in size since the previous investigation and it now had a distinct inferior convex contour suggestive of a cyst. Cholecystography again failed to show filling of the gall bladder.

In order to study more closely the character of this unusual image, it was punctured with a fine needle. Bile coloured, fairly thick fluid was obtained. Then 20 ccs. of perabrodil were injected slowly. The patient was then radiographed lying on his right and left sides, supine, prone and standing-*using the horizontal beam each time.* (See figs. 1—4.)

From these roentgenograms it can be assumed that the contrast medium was deposited in a cyst as large as a child's head situated just below a normal liver. The cyst extended from the right flank beyond the midline nearly to the left flank, and from the anterior abdominal wall to the spine. With the patient on the right side, and, to some extent, even with the patient prone, there could be seen a thumb-sized, sausage-shaped, contrast filled appendage extending upwards in a hook-shaped manner. (See fig. 1.) This appendage had the appearance of a slightly enlarged bladder.

These findings made it reasonably certain that the large cyst was a common duct cyst connected with the gall bladder by a wide cystic duct. This conception was rendered even more likely by the roentgenological finding of failure of the gall bladder to be visualized on cholecystography.

In spite of the patient's rather poor general condition, it was felt that an *operation* should be attempted. As soon as the abdomen was opened, a cyst larger than a child's head was encountered. It contained about 650 ccs. of bile coloured fluid. A slightly dilated gall bladder was found somewhat displaced, anteriorly and to the right. It was S-shaped and was connected with the cyst by a wide cystic duct. The patient's condition was so bad that it was felt that the extirpation of the cyst should be postponed, and only drainage through the anterior abdominal wall instituted. However, the patient died of a post-operative peritonitis due to the giving way of sutures and leakage.

At the time of operation no sign of irritation from the contrast medium could be noted. The subsequent autopsy confirmed the roentgenological and operative findings. In the upper part of the abdomen could be observed a cyst as large as a child's head which consisted of the cystic and common hepatic ducts and the common bile duct except for a distance of 1 cm in the region of the papilla of Vater. Here the common bile duct was of normal appearance. It contained no valves or any other obstructing lesion. Both hepatic ducts emptied at a considerable distance from each other into the cyst. They were not

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. Patient on right side. The injected contrast medium has collected in the gall bladder and in the widened cystic and common bile ducts.
Fig. 2. Patient on left side.
Fig. 3. Supine.
Fig. 4. Standing. Contrast medium has now sunk to the bottom of the cyst.

widened, nor was there any dilatation of the intrahepatic bile channels. The liver was of normal size and without visible changes.

In the *differential diagnosis* liver tumor, intrahepatic cyst, pancreatic tumor or cyst, renal cyst and hydronephrosis were considered. Urography ruled out the presence of any kidney lesion. The differentiation between the other conditions was difficult. The direct injection of the contrast medium into the cyst solved the problem. The puncture and injection produced no ill effects.

The *mechanism* involved in the formation of these common duct cysts is thought by most authors to be of two types — either they are congenital anomalies or arise as the result of obstruction (valves or strictures) in the most distal part of the common bile duct. Those which are of the first type are larger than the others.

SUMMARY

The author describes a case of a cyst of the common bile duct in which the precise roentgenological diagnosis can be credited to the injection of a water soluble contrast medium directly into the cyst followed by radiography with a horizontal beam and the body in various positions.

ZUSAMMENFASSUNG

Verf. berichtet über einen Fall von Choledochuszyste, bei dem durch Einspritzung eines wasserlöslichen Röntgenkontrastmittels direkt in die Zyste und Röntgenaufnahmen in verschiedenen Körperstellungen mit wagerechter Strahlenrichtung die röntgenologische Spezialdiagnose gestellt werden konnte.

RÉSUMÉ

L'auteur relate un cas de kyste du cholédoque où le diagnostic radiologique de nature put être posé grâce à l'injection d'une substance opacifiante hydrosoluble directement dans le kyste, et à la prise de clichés radiographiques dans diverses positions du corps, le rayon principal étant dirigé horizontalement.

LITERATURE

DI NATALE: Arch. ital. chir. 23: 553, 1929.
SMITH: Arch. Surg. 44: 963, 1942.
THOMAS: Zbl. Chir. 54: 2289, 1927.
WRIGHT: Brit. journ. radiol. 8: 227, 1935.

FROM THE UNIVERSITY CLINIC, DEPARTMENT OF RADIOLOGY, OSLO, NORWAY
(CHIEF: PROFESSOR T. DALE, M. D.)

ANOMALIES OF THE SPINE IN ANOMALIES OF VISCERA AND CONSTITUTION[1]

A radiological contribution to the physiology of development of man and to the understanding of the bearing of the anomalies of the spine on pathology

By

Johan Torgersen

The work of SPEMANN and other embryologists has demonstrated that development depends upon the stimulus of an active evocator, organizer, on tissue in a receptive condition. They have further shown that the notochord and the dorsal lip of the blastopore are the fundamental organizers in amphibia. It has been demonstrated that the corresponding region is of the same importance in higher vertebrates. Are there any signs that this also is the case in man?

The observations in the present paper demonstrate the advantage of radiography in the study of variations and anomalies in man, and the importance of knowledge in certain fields of biology in the interpretation of roentgen pictures.

Lumbosacral defect and abnormalities of the urinary tract

Case 1 (fig. 1). A girl, 3 years of age, was admitted to the Pediatric Department because of enuresis. Urography revealed a double pelvis and ureter in the right kidney. The most striking abnormality in the picture was overlooked, however. Some weeks later she was admitted to another hospital (Deaconess Hospital, Oslo), and during the urography the diagnosis was made by FRIIS. The child had a large defect of the sacral bone.

It should therefore be regarded as a routine to inspect the coccygeal and sacral bones in the presence of symptoms from the urinary

[1] Submitted for publication, Aug. 21, 1947.

Fig. 1.

tract. These defects are rare; only about 50 cases are described in literature. Such defects are regularly combined with malformation of the urinary tract, and incontinence.

Case 2 (figs. 2 and 3). A girl, 17 years of age, had had no symptoms from the urinary tract, but had been operated on for imperforate anus in childhood. The picture demonstrated the peculiar recurved, tail-like sacral bone and a defect of the coccygeal bone. Further, 6 lumbar vertebrae with fusion of two of them. Urography demonstrated that she had only one kidney.

These two cases must be classified as sireniform monsters with the lumbosacral defect, the deviation of the spine, and the imperforate anus. Anomalies in the segmentation of the spine are common complications in these monsters. The abnormalities in both cases are very similar to those described in mice by DUNN and GLUECKSON-SCHOENHEIMER, 1947. These authors are of the opinion that the effect of these mutations may be explained by the supposition that they affect »an inductive relationship by which the development of parts of the gut, the urogenital system and the axial skeleton are determined». They emphasize that these mutations may provide unusual or unique opportunities for the study of this problem.

Fig. 2.

Fig. 3.

Lumbosacral defect and visceral inversion

Case 3 is a boy whom I examined several times over a period of three years, from the age of half a year up to 3½ years. He had imperforate anus and total visceral inversion. This combination has been observed several times.

I could not find any trace of bone formation in the coccygeal bone during roentgen examination over three years. I investigated the spine of the parents and two siblings without finding anything particular.

This case directed my attention towards a connection between the anomalies of the spine and the asymmetry and topography of the viscera. PRICE mentions, in an article on plastic operations for incontinence of urine and feces, a Chinese girl with a defect of the sacro-

Fig. 4.

Fig. 5.

lumbar portion of the spine, visceral inversion and malformation of the urinary organs.

The last case shows the importance of the primitive streak and the notochord in development of the normal asymmetry of the viscera. In the laboratory of DUNN, five cases of sirens were found in a strain of short-tailed mice, and one of them showed dextrocardia. The fact that asymmetry reversal is so infrequently observed in short-tailed mice may depend upon the varying tendency to visceral inversion in different species. Although it is a rare anomaly, occurring in man with a frequency of about $^1/_{8000}$, spontaneous inversion apparently occurs more frequently in amphibia, salmon and man than in other commonly observed species. Up to the present, I have examined 146 individuals with visceral inversion. Two of them demonstrated a very rare mal-

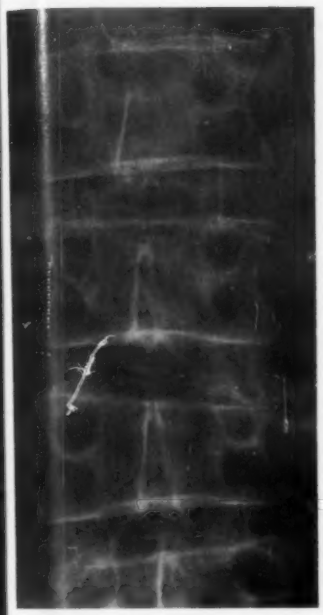


Fig. 6.

Fig. 7.

formation of the spine, a hemispondylus. It may safely be excluded that the occurrence of two such cases among 146 individuals is accidental.

Case 4 (figs. 4 and 5). A man, 27 years of age, with total visceral inversion, had hemispondylus of a thoracic vertebra and a severe kyphoscoliosis. Furthermore, he had a large defect of the arch of a lumbar vertebra. Not in all cases are the malformations so evident.

Case 5 (fig. 6). In a man, 60 years of age, with total visceral inversion was found a hypoplasia of the third lumbar vertebra.

Case 6. In a woman, 40 years of age, was found a severe scoliosis, congenital heart disease and inversion.

Case 7 (fig. 7). A woman, 26 years of age, with total visceral inversion, had 6 lumbar vertebrae, similar to the siren in case 2. Two of her brothers had five lumbar vertebrae

Fig. 8.

and a lumbosacral vertebra. One of them had visceral inversion and the same was the case with another brother. The woman also had a hypoplasia of the left kidney. It is probable that the peculiar type of variation of the spine, the visceral inversion and the hypoplasia of the kidney are not accidental, nor is the similarity with the findings in case 2.

Anomalies of the spine, visceral inversion and peculiarities of constitution

Case 8 (fig. 8). A girl, 4 years of age, with total visceral inversion and congenital heart disease, had a hemispondylus of the third thoracic vertebra. She showed also a deformed chest and a short neck resembling a Klippel-Feil syndrome. She was, perhaps as a consequence of the heart disease, of short stature. Her body was dysplastic with a pronounced panniculus adiposus of the shoulders. This has been observed several times in Klippel-Feil's syndrome. It has been designated dystrophia brevicollis in order to emphasize the constitutional peculiarities. HOMMA, 1944, has observed a case of visceral inversion in a similar malformation of the cervical spine. The observations are in accordance with the results of the well-known experiments in amphibia. In the neurula stage a square piece of medullary plate, together with the roof of the primitive gut lying under it, was cut out and replaced in the reversed position. From these embryos tadpoles were reared, many of which had transposition of viscera. (SPEMANN, MEYER.)

LEHNER has observed dystrophia brevicollis with signs of disturbances in the hormone balance, and also adipositas, hirsutism and diabetes,

and he found these symptoms without sign of brevicollis in other members of the families.

Such symptoms also have been observed in an anomaly of the occipital vertebra, basilar impression. According to a common opinion the cause of the correlation between these anomalies of the base of the skull and endocrine disturbances is to be found in a pressure on the base of the brain. Such a mechanical explanation is not sufficient, however. This may be a factor of importance in some cases. However, it is more probable that the anomalies of the spine and the neurovegetative and endocrine disturbances, especially those from the hypothalamus and the hypophysis, are different effects of one set of causes, disturbances in inductive influences from the primitive notochord. The tail and the anus are caudal, the hypophysis cranial products of the influence of the primitive notochord and of the primitive streak.

It may be expected, therefore, that imperforate anus in the same way as anomalies of the spine, is connected with anomalies of the hypophysis and of the hypothalamus. This is also the case. In a constitutional anomaly as LAURENCE-MOON-BIEDL's syndrome, comprising dystrophia adiposogenitalis, retinitis pigmentosa and polydactylia, imperforate anus and malformation of the cervical spine (LIECHTI, 1944), are rather frequent complications. MOBERG has observed a case similar to case 3 in this paper: Situs inversus totalis, imperforate anus and lipodystrophia progressiva. These observations demonstrate the connection between bilateral symmetry, segmentation of the spine and kidney, and the viability. The cause of the deleterious effect of the short-tailedness may be that an extreme shortening of the tail results in the disturbance of a fundamental organizer, in a lumbosacral defect, anomalies of the spine and imperforate anus, in disturbances of segmentation, first of all in the kidneys, abnormality in the asymmetry of the viscera and disturbances in hypophysis and brain manifesting themselves as constitutional peculiarities. The expression of the mutation in the house-mouse ranged from a nearly complete lethal to that of a postnatal growth-retarding factor with minor effects on the tail. All the animals were smaller than normal. I suppose the observations in man may be useful as a supplement to the observations in mice, no species being investigated as to pathology in the same degree as man.

In development only a few of the many potencies of the early stages are realized. It must be taken into consideration that every single individual is double in a latent way. FELLER emphazised that in double-monster examined by him, doubling of the notochord may be demonstrated. In a minimal doubling of the nose, the hypophysis only may be double.

Fig. 9.

Fig. 10.

There are transitions from twins with separate axial skeletons to single individuals with a double hypophysis only. In such slight doublings of the cervical spine and the hypophysis imperforate anus has been observed. It is evident that such processes are not without influence on the symmetry of the viscera and on the viability. The cranial part of the notochord and the hypophysis, play a rôle in this connection. In experimental embryology there is a high correlation between twinning, asymmetry reversal and decreased viability, in human pathology between malformation of the spine, disturbance of segmentation, abnormalities of symmetry and asymmetry and constitutional peculiarities.

Case 9 (figs 9 and 10), illustrates the above. A woman, 32 years of age, with acromegaly, enlarged sella turcica, thickening of the skull and an assimilation between the fifth and sixth cervical vertebrae.

The spine in case 7 does not show any anomaly, however, only the rare but normal variation of six lumbar vertebrae. May not only anomalies, but also normal variations, cause abnormalities like visceral inversion and hypoplasia of the kidney? In other words, may the genes at the base of the normal variations in some cases, by their manifold effect cause such disturbances in the symmetry and segmentation.

I have investigated the incidence of six lumbar vertebrae in individuals with situs inversus. Among 56 cases I found 6, approximately 11 per cent, and in a control material of 500 roentgen pictures 14 cases, 2.8 per cent. The difference in the two groups is not sufficient for statistical proof. The result, however, indicates that the variability in the spine is relatively large in situs inversus.

The advantage of investigating a rare anomaly such as situs inversus is that the chance is small that another rare anomaly in the same individual is accidental. The results of the examination of the variations in the spine illustrate that even in such an exceedingly rare anomaly as situs inversus a great material must be at hand to prove a correlation to relatively common traits. Instructive in this respect is spina bifida of the first sacral vertebra. In the 56 cases of inversion, the incidence was not much higher than in control materials in which it is 10—20 per cent. With such high incidence it is difficult to prove the correlation with any other anomaly.

The older morphologists considered that they could reconstruct the whole individual from a minute detail if they only knew the significance of normal variations and anomalies. Experimental embryology and genetics have broadened the knowledge in these fields, and a certain knowledge in these branches of morphology is indispensable to the investigator of these anomalies in man. An apparently insignificant morphological detail may tell something, perhaps even something of fundamental importance, about an individual.

SUMMARY

Two cases of lumbosacral defect demonstrate the connection between the development of the tail, spine and kidneys, seven cases the combination of anomalies of the spine and visceral inversion. Two cases show the combination of anomalies of the spine and constitution.

The observations indicate a developmental relationship between the structures affected, particularly between fundamental characters such as segmentation, bilateral symmetry and constitution. The facts available may be explained by supposing that inductive relationships exist between the notochord and the viscera in man as in amphibia.

The observations in this paper are very similar to those described by DUNN and GLUECKSON-SCHOENHEIMER in short-tailed mice.

ZUSAMMENFASSUNG

Zwei Fälle von lumbo-sakralen Defekt veranschaulichen die Beziehungen der Entwicklung von Schwanz, Wirbelsäule und Nieren, sieben Fälle die Kombination von Anomalien der Wirbelsäule und Situs inversus der Eingeweide. Zwei Fälle zeigen eine Kombination von Anomalien der Wirbelsäule und der Konstitution. Die Beobachtungen deuten auf ein entwicklungsmässiges Verhältnis hin zwischen den befallenen Strukturen, besonders zwischen grundlegenden Zügen, wie Metamerie, bilaterale Symmetrie

und Konstitution. Die vorliegenden Tatsachen lassen sich durch die Annahme eines induktiven Verhältnisses zwischen Chorda und Eingeweiden beim Menschen als bei der Amphibie erklären. Die Beobachtungen in dieser Arbeit gleichen sehr den von Dunn und Glueckson-Schoenheimer bei kurzschwänzigen Mäusen beschriebenen.

RÉSUMÉ

Deux cas de défauts lombo-sacrées démontrent la relation existant entre le développement de la queue, du rachis et des reins, sept cas illustrent la combinaison d'anomalies de l'épine dorsale avec l'inversion des viscères. Deux cas montrent la combinaison d'anomalies de la colonne vertébrale avec la constitution. Les observations indiquent qu'il y a une relation, au cours du développement, entre les structures touchées, en particulier entre des caractères fondamentaux comme la segmentation, la symétrie bilatérale et la constitution. Les faits dont on dispose peuvent être expliqués en supposant qu'il existe des relations par induction entre la notochorde et les viscères, chez l'homme comme chez les amphibies. Les observations de cet article sont très semblables à celles de Dunn et Glueckson-Schoenheimer chez les souris à queue courte.

REFERENCES

Dunn, L. C., and Glueckson-Schoenheimer, S.: A new complex of hereditary abnormalities in the house mouse. J. Exper. Zool. 104, 1947.

Feller, A.: Über geringe Grade von Diprosopie. Zschr. Anat. u. Entw.g. 94, 1931.

Feller, A. und Sternberg, H.: Über den vollständigen Mangel der unteren Wirbelsäulenabschnitte und seine Bedeutung für die formale Genese der Defektbildungen des hinteren Körperendes. Virch. Arch. 280, 1931.

Glueckson-Schoenheimer, S. and Dunn, L. C.: Sirens, Aprosopi and Intestinal Abnormalities in the mouse. The Anat. Record. 2—1, 1945.

Homma, H.: Ein Fall von Situs Viscerum inversus partialis, Verdoppelung des Ductus venosus Aranti und Dystopie des linken Herzohres. Virch. Arch. 312, 1944.

Lehner, O.: Klippel-Feil-Syndrom mit innersekretorischen Störungen. Fortschr. a. d. G. d. Rtg. strahlen 47, 1943.

Liechti, A.: Die Röntgendiagnostik der Wirbelsäule. 1944.

Moberg, E.: Två fall av vänstersidig appendicit vid situs inversus totalis. Nord. med. I, 1939.

Price, P. B.: Plastic Operations for Incontinence of Urine and of Feces. Arch. of Surgery, 26, 1933.

Rinvik, R.: A case of the Klippen-Feil-Syndrome (Congenital Synostosis of the Cervical Vertebrae). Acta Pæd. 31, 1944.

Sinclair, J. G., Duren, N., Rude, J. C.: Congenital Lumbosacral Defect. Arch. of Surg. 43, 1941.

FROM THE DANISH CANCER REGISTRY UNDER THE NATIONAL ANTI-CANCER LEAGUE, COPENHAGEN, DENMARK (DIRECTOR: JOHANNES CLEMMESEN, M. D.)

THE INCIDENCE OF MALIGNANT DISEASES IN DENMARK 1942—1944

by

Johannes Clemmesen, M. D., and *Thøger Busk*, Lic. act.

It is our intention in the following to give the figures for »cancer» incidence in Denmark in the years 1942—44 as worked out by The Danish Cancer Registry under The National Anti-Cancer League. Such figures may be of practical value for many purposes, and in order to give an estimation of their validity which naturally will vary to some extent with the site of the tumour, we have also given the number of cases treated in hospital, verified histologically, and subject to autopsy, worked out separately for each site.

To some readers it may seem extravagant to open a special institute for statistical examinations of a single group of diseases. But just as it is the aim of experimental cancer research to examine conditions favouring or inimical to the origin and growth of cancer in animals, it is the task of statistical cancer research to examine under which conditions the incidence of human cancer will increase or decrease in frequency. Besides, but not less, cancer statistics should serve as a means to therapeutical statistics.

Organisation

Because of the increasing proportion of cancer patients cured, mortality statistics are becoming increasingly inadequate for such purposes. Consequently, in 1942 the Danish National Anti-Cancer League with the support of The National Health Service and in collaboration with the Medical Association opened The Danish Cancer Registry. The King Christian X Foundation contributed annual grants, and the state rendered the premises and the technical collaboration of The Statistical Department.

[1] Submitted for publication, Oct. 21, 1947.

The start of the Registry took place on May 5, 1942 under the supervision of representatives of the various bodies concerned. A minor executive committee following the work during the first period consisted o Professor ENGELBRETH-HOLM, Medical Registrar MARIE LINDHARDT B. P. Sc., and Chief Radiologist JENS NIELSEN.

A specialist in clinical medicine and in pathology, familiar with experimental cancer research, has been in charge of the work, assisted i the statistical field first by a secretary from the Statistical Department o State, and later by an assistant lecturer from the University Department for Actuarial Mathematics.

All patients with malignant diseases admitted in Danish hospitals are notified to the Registry, and these notifications are supplemented with copies taken from all death certificates for persons who — previously or at the time of their death — are known to have suffered from such diseases. Death certificates thus make out for notifications from general practice, and are helpful in checking hospital notifications. Autopsies are notified separately.

Notifications are made according to a voluntary scheme covering all Danish hospitals. A token salary of 1 Krone is paid for each notification and for the cancellation of a previous one. Notifications are copied and filed according to birth date. A key register according to alphabetical order of names is also kept. Deaths are filed according to diagnosis, each year separately. The technical work is carried out following the Hollerith system.

Notified are: all cases of malignant diseases comprising brain tumours, leukemia, Hodgkin's disease and myelomata. The items given for each case comprise the patient's name, the date and place of birth, occupation, civil condition and address. Furthermore, notifications state the date of the first admission in any hospital due to the disease in question and the date of the admission into the notifying department, and if possible the number of the case record, and day of departure, respectively of death. Clinical and histological diagnoses are also stated together with methods of treatment and operations performed. Twins are notified on special forms.

Notifications from pathologists besides the necessary civil items give the day of death, number of the autopsy and all patho-anatomical diagnoses. They serve as one control of the efficiency of the system. Another is formed by the material of death certificates. These are legal documents and 996 out of thousand are issued by doctors. For a further evaluation of Danish death certificates readers are referred to CLEMMESEN 1941 and CLEMMESEN & BUSK II. Suffice it to say that their main shortcoming with regard to cancer statistics is the lacking of information about the time for the beginning of the disease. This prevents the work-

ing out of reliable age distribution curves for cases not admitted in hospitals, so that such curves for research purposes must be based on hospital cases.

As to the quality of the material in general we shall refer to the following tables giving the percentage of cases treated in hospital, of histological verifications, and of autopsies performed. Judged from these figures it seems that the whole system is working satisfactorily.

All cases registered have been classified by one of us (C) personally at least once. Half of the present material has furthermore been revised once by the same worker.

General Review of Results

In order to create a material covering the period from Jan. 1, 1942 to the opening of the Registry on May 5, hospitals were asked to make retrospective notifications for the four months concerned. The response was satisfactory. Similarly it was attempted to carry out a census of all cancer cases under treatment in Denmark on February 15, 1943. This was carried out in collaboration with The National Health Service, and answers were obtained from all doctors and hospitals. The results have been stated elsewhere by CLEMMESEN & JOHS. NIELSEN and CLEMMESEN & MARIE LINDHARDT, and have confirmed the superiority of the registration method.

The research work of the Registry has been following two main lines:

Previous studies of the relation of occupation to cancer mortality had led to the conclusion that it was desirable at the same time to examine both the action of hereditary factors on several forms of cancer, and the effect of social factors in the same population. Already before the opening of the Registry a collaboration therefore existed between its Head and Director TAGE KEMP, M. D. of the University Institute of Genetics, supported by The King Christian X Foundation. The first results of these combined studies have already appeared in two monographs by OLUF JACOBSEN on Heredity in Breast Cancer and by VIDEBÆK on Heredity in Human Leukemia, and a paper by TH. BUSK on the same subjects.

Comparative studies on heredity of cervical and fundus cancers have been undertaken by O. BRØBECH and histological and statistical studies on prostatic cancer have been carried out by H. STARKLINT in collaboration with The University Institute of Pathological Anatomy which also supported the work of Dr. VIDEBÆK.

Besides these studies it was necessary to create a base for comparisons between the results from the Registry in Denmark and those from other European countries relying on mortality statistics. So comparisons were

carried out between the Danish cancer mortality figures from the years about 1938 and the corresponding values from England and Switzerland the three countries showing respectively the third, second and highest European cancer mortalities. This was also done with regard to tumours of accessible and inaccessible sites, and comparisons are following between Danish Cancer mortalities then and now, and between the latter and the figures from the present statistics.

At the same time current problems have been commented on, as in the case of the rise in frequency of lung cancer in Denmark, and Danish doctors have regularly been kept informed of the activities of the Registry through the Medical Weekly, »Ugeskrift for Læger». Contact with other European workers in the same field was established through a symposion in September 1946 at the University of Copenhagen, and a resolution urging the establishment of an international system of cancer statistics was passed and later delivered to the United Nations.

The Tables

The following tables cover the first three years of the Registry *i. e.* 1942—44. For detailed studies it will be necessary to know the age distribution of the population at risk, and of the patients with each single form of cancer, and such figures will be published as soon as possible. However, for practical purposes the present material will do.

An important difficulty for cancer statistics of this kind is caused by the fact that hospital treatment of the different forms of cancer takes place to a very varying extent, so that the uniformity of the material is endangered. The heaviest consequence from a statistical point of view is that as death certificates do not state the time for the beginning of the disease, which is most desirable for the construction of the important age distribution curves, these curves will as a rule be inaccurate if comprising the entire material, but presumably correct when limited to hospital cases. These are classified according to the month of their first admission in hospital for the present disease and will furnish an excellent material for finer analyses.

Even enforced notification from general practitioners of the date for the first symptoms would not be very helpful in this respect, as it is known from experience that such dates must be unreliable and for some purposes it will be sufficient to include cases from private practice classified according to their age at death. As long as the fraction treated in private practice remains constant this procedure will often be defensible, though its dangers must be kept in mind. But if — as the case has been in recent years — the number of hospital beds per head of the population is decreasing, patients with for instance gastric cancer will be dismissed

Histological Verification of Malignant Diseases in Denmark 1942—1944

The Danish Cancer Registry under the National Anti-Cancer League

Sites	Males				Females			
	Hospital cases	%	Of which histologically verified absolute	%	Hospital cases	%	Of which histologically verified absolute	%
Lip	350	99	244	70	31	91	20	65
Upper digest. & respir. passag.	330	76	267	81	171	69	138	81
Esophagus	303	70	144	48	136	63	74	54
Stomach	1 618	61	393	24	1 032	47	252	24
Intestines (unspec.)	54	55	15	28	42	33	17	40
Colon	379	65	151	40	396	55	179	45
Rectum	955	81	617	65	585	78	374	64
Sigmoid	252	92	94	37	221	91	100	45
Liver	132	49	55	42	183	43	68	37
Pancreas	152	70	45	30	145	64	33	23
Abdomen	72	41	32	44	195	42	50	26
Lung	448	75	234	52	121	59	45	37
Uterus, Cervix	—	—	—	—	1 633	98	1 549	95
» Fundus	—	—	—	—	509	92	481	94
» unspecified	—	—	—	—	32	13	17	53
Ovary	—	—	—	—	524	82	393	75
Other female genital organs..	—	—	—	—	138	90	124	90
Breast	19	79	18	95	2 313	83	2 021	87
Testis	144	86	135	94	—	—	—	—
Penis	78	91	71	91	—	—	—	—
Prostate	479	76	246	51	—	—	—	—
Kidney	156	75	110	71	136	77	96	71
Bladder	215	77	115	53	103	82	56	54
Skin	1 010	95	820	81	782	96	620	78
Brain	154	59	110	71	122	54	89	73
Metastases	155	65	58	37	144	71	55	38
Lymphogranulomatosis (Hodgkin)	103	88	76	74	88	79	67	76
Leukemia	322	81	—	—	232	90	—	—

to die in their homes to an increasing extent, and in the statistical tables their numbers will fall, until the time for their average survival has passed, and is followed by an increase in the number »notified» through death certificates from general practitioners.

(This reservation has caused the misapprehension that the material of the Danish Cancer Registry comprises only hospital cases. In our opinion the same fault — unveiled or not — will be found in most cancer statistics except when dealing with materials as for instance our group of uterine cancers which almost exclusively are treated in hospitals, which moreover are very uniform.)

Another difficulty, known from other cancer registries, is that the figures from the first years will fall, presumably because a number of cases originating in earlier years in spite of all measures will be classified as belonging to the period after the start of the registry. The degree of this phenomenon seems to vary from one form of cancer to another.

Autopsies on Cases of Malignant Diseases in Denmark 1942—1944 as percent of deaths.

The Danish Cancer Registry under The National Anti-Cancer League

Site	Males			Females		
	Deaths	Autopsies	Per cent	Deaths	Autopsies	Per cent
Digestive System						
Lip	52	7	13	7	—	—
Tongue	263	76	29	158	14	9
Esophagus	434	128	29	198	33	17
Stomach	2 544	392	15	2 148	258	12
Intestine (unspec.)	147	23	16	160	14	9
Colon	539	118	22	684	116	17
Sigmoid	259	102	39	225	77	34
Rectum	950	205	22	605	134	22
Liver	284	89	31	416	88	21
Pancreas	233	104	45	240	78	32
Respiratory System						
Lung	633	288	45	212	67	32
Uterus						
Cervix	—	—	—	840	249	30
Fundus	—	—	—	214	57	27
Unspecified	—	—	—	262	18	7
Female Genital System						
Ovaries	—	—	—	547	143	26
Other female genital organs	—	—	—	109	24	22
Male Genital System						
Prostate	582	137	24	—	—	—
Testis	94	19	20	—	—	—
Penis	42	17	40	—	—	—
Breast						
Breast	12	3	25	1 678	302	18
Urinary System						
Kidney	216	104	48	170	65	38
Bladder	260	62	24	119	35	29
Skin						
Skin	225	23	10	128	11	9
Nervous System						
Brain	271	85	31	220	69	31
Uncertain Sites						
Metastases	198	22	11	185	28	15
Abdomen	260	14	5	551	25	5
Others	153	41	27	203	59	29
Systemic diseases						
Myeloid Leukemia	107	42	39	113	54	48
Lymphoid Leuk.	194	60	31	103	33	32
Myelomata	96	28	29	78	15	19
Lymphogranul. (Hodgkin)	110	38	35	88	13	15

Malignant diseases registered by The Danish Cancer Registry 1942—1944.

Site	Males					Females				
	1942	1943	1944	Total	Per cent	1942	1943	1944	Total	Per cent
Buccal Cavity and Pharynx	*242*	*229*	*175*	*646*	*5.71*	*86*	*68*	*78*	*232*	*1.61*
Lip	121	124	107	352	3.11	9	14	11	34	0.24
Tongue	22	20	8	50	0.44	17	11	11	39	0.27
Mouth	22	17	15	54	0.48	16	10	13	39	0.27
Jaw & Jawbone	22	9	12	43	0.38	14	8	13	35	0.24
Tonsill. (Throat)	13	12	9	34	0.30	1	2	5	8	0.06
Pharynx	28	34	17	79	0.70	11	10	10	31	0.21
Salivary glands	14	13	7	34	0.30	18	13	15	46	0.32
Digestive organs and Peritoneum	*2 089*	*1 966*	*1 772*	*5 827*	*51.45*	*1 776*	*1 673*	*1 618*	*5 067*	*35.14*
Esophagus	171	153	107	431	3.81	93	60	63	216	1.49
Stomach	954	899	787	2 640	23.30	742	760	716	2 218	15.39
Duodenum	8	5	4	17	0.15	5	6	8	19	0.13
Small Intestine	8	11	9	28	0.25	4	7	8	19	0.13
Intestines (unspec.)	30	39	29	98	0.87	53	37	37	127	0.88
Colon	201	201	185	587	5.18	266	234	218	718	4.98
Rectum	414	383	389	1 186	10.47	265	248	238	751	5.21
Sigmoid	92	100	81	273	2.41	92	84	68	244	1.69
Anus	3	1	2	6	0.05	4	2	3	9	0.06
Liver (primary)	12	15	7	34	0.30	10	16	14	40	0.28
Liver (not stated as primary)	80	52	64	196	1.73	105	65	104	274	1.90
Biliary passages	16	7	14	37	0.33	33	37	44	114	0.79
Pancreas	75	70	72	217	1.92	66	88	72	226	1.57
Mesentery and peritoneum	9	20	11	40	0.35	33	18	21	72	0.50
Others	16	10	11	37	0.33	5	11	4	20	0.14
Respiratory System	*290*	*253*	*248*	*791*	*6.99*	*117*	*93*	*73*	*283*	*1.96*
Nasal cavity	15	11	11	37	0.33	14	4	6	24	0.16
Larynx & Trachea	37	38	27	102	0.90	13	7	5	25	0.17
Lung (primary)	78	89	105	272	2.40	14	24	9	47	0.33
Lung (not stated as primary)	137	101	90	328	2.90	66	52	40	158	1.10
Pleura	12	7	7	26	0.23	5	4	6	15	0.10
Mediastinum	11	7	8	26	0.23	5	1	7	13	0.09
Pericard	—	—	—	—	—	—	1	—	1	0.01
Breast	*7*	*5*	*12*	*24*	*0.21*	*936*	*925*	*915*	*2 776*	*19.25*
Male Genital Organs	*333*	*288*	*268*	*889*	*7.86*	—	—	—	—	—
Scrotum	4	3	—	7	0.06	—	—	—	—	—
Prostate	234	199	195	628	5.55	—	—	—	—	—
Testis	59	58	50	167	1.48	—	—	—	—	—
Penis	35	28	23	86	0.76	—	—	—	—	—
Others	1	—	—	1	0.01	—	—	—	—	—
Uterus	—	—	—	—	—	*848*	*805*	*800*	*2 453*	*17.01*
Cervix	—	—	—	—	—	544	563	555	1 662	11.53
Fundus	—	—	—	—	—	189	174	190	553	3.83
Unspecified	—	—	—	—	—	115	68	55	238	1.65

Malignant diseases registered by The Danish Cancer Registry 1942—1944. (Cont.)

Site	Males					Females				
	1942	1943	1944	Total	Per cent	1942	1943	1944	Total	Per cent
Other Female Genital Organs	—	—	—	—	—	*263*	*262*	*265*	*790*	*5.48*
Ovary	—	—	—	—	—	219	207	210	636	4.41
Fallopian tube	—	—	—	—	—	3	3	3	9	0.06
Vagina	—	—	—	—	—	19	14	14	47	0.33
Vulva	—	—	—	—	—	22	38	37	97	0.67
Others	—	—	—	—	—	—	—	1	1	0.01
Urinary Organs	*180*	*170*	*141*	*491*	*4.34*	*106*	*126*	*83*	*315*	*2.19*
Kidney	77	76	54	207	1.83	57	77	43	177	1.23
Bladder	102	93	86	281	2.48	45	43	38	126	0.88
Ureter	1	1	—	2	0.02	—	2	—	2	0.01
Urethra	—	—	1	1	0.01	4	4	2	10	0.07
Skin	*344*	*388*	*336*	*1 068*	*9.44*	*231*	*286*	*293*	*810*	*5.62*
Squamous cell ca.	324	366	324	1 014	8.96	200	267	259	726	5.04
Melanoma	20	22	12	54	0.48	31	19	34	84	0.58
Brain and Central Nervous System	*139*	*98*	*78*	*315*	*2.79*	*129*	*92*	*92*	*313*	*2.17*
Brain	107	86	68	261	2.31	88	60	76	224	1.55
Others	32	12	10	54	0.48	41	32	16	89	0.62
Other Sites	*122*	*144*	*129*	*395*	*3.45*	*122*	*117*	*124*	*363*	*2.52*
Suprarenal Glands	1	3	4	8	0.07	2	3	2	7	0.05
Bones and joints	28	17	20	65	0.57	14	18	15	47	0.33
Thyreoid gland	8	10	6	24	0.21	32	19	23	74	0.51
Eye	20	22	18	60	0.50	12	8	13	33	0.23
Metastases	65	92	81	238	2.10	62	69	71	202	1.40
Tumors of Unspecified Nature ..	*91*	*91*	*103*	*285*	*2.52*	*194*	*201*	*194*	*589*	*4.09*
Abdomen	56	52	66	174	1.54	155	159	155	469	3.25
Neck	4	2	2	8	0.07	2	1	4	7	0.05
Thymoma	—	—	—	—	—	—	—	—	—	—
Head	1	1	1	3	0.03	1	—	2	3	0.02
Pelvis	2	3	4	9	0.08	8	12	7	27	0.19
Mb. lymph.	27	30	25	82	0.72	23	25	21	69	0.48
Thorax	—	3	3	6	0.05	2	—	2	4	0.03
Other Sites	1	—	2	3	0.03	3	4	3	10	0.07
Systemic Diseases:										
Myeloid Leukemia	33	29	33	95	0.84	34	41	29	104	0.72
Lymphoid Leukemia	66	77	61	204	1.80	29	35	25	89	0.62
Leucosis typi incerti	13	22	10	45	0.40	7	9	6	22	0.15
Myelomata	17	14	24	55	0.49	21	13	8	42	0.29
Lymphogranulomatosis (Hodgkin)	39	42	36	117	1.03	55	33	24	112	0.78
Sarcomas	21	24	25	70	0.62	17	17	24	58	0.40
	4 026	**3 840**	**3 451**	**11 317**	—	**4 971**	**4 796**	**4 651**	**14 418**	—

Thus, it will be noticed that skin cancer, which usually takes a short course does not exhibit this feature.

The first table gives the per cent of cases treated in hospital. It should be remembered that in Denmark private clinics are very rare, and

most of them are covered by our notification system, so that the figures given must be very accurate. The number of deaths taking place in hospitals have been stated previously (CLEMMESEN 1941. The authors II).

Among the more important cancers with a high percentage of hospital cases — and correspondingly of histological examinations — we notice uterine cancers with figures exceeding 90 %, skin cancer and cancer of the breast. Also cancer of the lip shows this feature, but when sigmoid cancer shows a high percentage it is probably because this diagnosis is almost exclusively passed in hospitals which alone are capable of localising the tumour with an accuracy permitting the use of this expression.

Similar views should be adopted in scrutinizing the table on autopsies performed, for instance with regard to the high frequency of autopsies among lung cancers. Presumably this cancer is detected less frequently than it ought to be, and to a large extent only post mortem. Uncertain sites must naturally be less frequently represented among the material of autopsies.

For all the differences between the single forms of cancer it would at present be equally mistaken to regard them as separate entities, and to treat them as variations of the same disease. In statistical research we think that the most fruitful attitude would be a combination of these views.

SUMMARY

The paper gives the figures for incidence of malignant diseases in Denmark for the years 1942—1944, as worked out by the Danish Cancer Registry. The figures include numbers of hospital treatments, autopsies performed, and histological verifications. The organisation and working system of the Registry is outlined together with its results from various fields of research.

ZUSAMMENFASSUNG

Die Arbeit bringt die Zahlen für das Auftreten maligner Leiden in Dänemark in den Jahren 1942—1944, wie sie aus dem Dänischen Krebsverzeichnis hervorgehen. Die Zahlen umfassen auch die Anzahl der Krankenhausbehandlungen, der verrichteten Sektionen und der histologisch bestätigten Fälle. Die Organisation und Arbeitsmethoden des Verzeichnisses werden skizziert, sowie auch die Ergebnisse auf verschiedenen Forschungsgebieten.

RÉSUMÉ

Le travail donne les chiffres des affections malignes au Danemark pendant les années 1942—1944, tels qu'ils ont été établis par le Service Danois de Statistique du Cancer. Ces chiffres comprennent le nombre des traitements hospitaliers, celui des autopsies et des contrôles histologiques. L'organisation et le système de travail du Service de Statistique sont esquissés, ainsi que les résultats obtenus dans divers champs de recherches.

LITERATURE

BUSK, TH.: Dot and Scatter Diagrams made by means of a typewriter. Journ. Roy. Stat. st. Soc., Vol. CIX, 451, 1946.

—: Some Observations on Heredity in Breast Cancer and Human Leukemia. Annals of Eugenics, in press.

CLEMMESEN, JOHANNES: Cancer and Occupation in Denmark, 1935—39. Nyt Nordisk Forlag, Copenhagen 1941.

CLEMMESEN, J. & JOHS. NIELSEN: Forelobige Oplysninger om Tællingen af Kræftpatienter den 15 Februar 1943. Ugeskr. f. Læger 808, 1943.

CLEMMESEN, J.: Cancer ventriculi i forskellige Lande. Ugeskr. f. Læger, 565, 1946.

Fra Cancerregisterets Arbejde. Ugeskrift for Læger.

I Om Alkohol og Kræft 619, 1946.

II Sygeligheden af Livmoderkræft 698, 1946.

III Sygeligheden af Brystkræft 905, 1946.

IV Kræftsygdommenes indbyrdes Fordeling 27, 1947.

V Om Hyppigheden af Lungekræft 315, 1947.

VI Kræftens Forekomst i Danmark 1942—44, 706, 1947.

CLEMMESEN, J. & TH. BUSK: On the apparent Increase in the Incidence of Lung Cancer in Denmark. Brit. Journ. Cancer, Vol. I, 253, 1947.

CLEMMESEN, J. & TH. BUSK: Cancer Mortality among Males and Females in Denmark, England, and Switzerland. Cancer Research.

I Denmark, England, and Switzerland. Vol. VII, 281, 1947.

II Danish Towns and Rural Areas. Vol. VII, 286, 1947.

III Cancers of Accessible and Inaccessible Sites, in press.

CLEMMESEN, J.: The Danish Cancer Registry. Problems and Results. Scand. Path. Conf. 1947. Acta path. & mic. Scand., in press.

CLEMMESEN, J. & MARIE LINDHARDT: Cancertællingen af 15 Febr. 1943. Rep. Dan. Nat. Health Serv., in press.

JACOBSEN, OLUF: Heredity in Breast Cancer. Nyt Nordisk Forlag. Copenh. 1946.

STOCKS, PERCY: Regional and local differences in Cancer Death Rates. Gen. Regist. Off. Med. and Popul. Subj. no. 1. H. M. Stationary Office, 1947.

SCHINZ, H. R.: Intereuropäischer Konferenz über Krebsstatistik in Kopenhagen, Sept. 1946. Schweiz. Med. Woch. 1194, 1946.

VIDEBÆK, A.: Heredity in Human Leukemia. Nyt Nordisk Forlag, Copenh. 1947.

FROM THE ROENTGEN DEPARTMENT, BISPEBJERG HOSPITAL, COPENHAGEN, DENMARK
(PHYSICIAN-IN-CHIEF: CHR. I. BAASTRUP)

A CASE OF MULTIPLE TRACHEAL DIVERTICULA[1]

by

Karen Nielsen

Tracheal diverticula demonstrated by bronchography having rarely been described there is reason to report the following case.

Case 184/4/44.

The patient, a married mechanic aged 51, was in the *Bispebjerg Hospital*, Medical Dept. C, from Febr. 26 to April 4, 1944. Had for many years been disposed to bronchitis. At the ages of 25 and 40 he was admitted to the *Øresundshospital* for pulmonary disease. The first time the stay in hospital was followed by 3 months of after-treatment in a sanatorium. Ostensibly no evidence of T. b. At the age of 45 admitted to the *Sundby Hospital* for pneumonia. On admission to the *Bispebjerg Hospital* the patient was in a reduced state, pneumonic with marked dyspnoea and slight cyanosis. Improved quickly under treatment. During stay in hospital copious expectoration, which decreased somewhat after postural drainage.

S. R.: 115—94 mm. Expect.: No T. b. (3 times). On dir. micr. Pneumococci of type 3. Eeg.: Slight right-sided preponderance, T_3 negative, otherwise norm. conditions. Bronchography (Fig. 1 and 2) revealed the following changes:

Considerable dilatation of the trachea both from side to side and antero-posteriorly. The tracheal wall presented larger and smaller, partly circumscribed and partly more diffuse protrusions in all directions. The lipiodol was accordingly seen to be unevenly distributed, being retained in recess-like diverticula situated laterally and posteriorly. The biggest ones, which were localized in the proximal half, were transverse, being 2 cm. broad and $^1/_2$ to 1 cm. high. A single one was seen to be rounded, being apparently a more sacculated diverticulum. All transition forms were seen between these big diverticula covering most of the posterior breadth of the trachea and some very small, often marked only by a slight intercartilaginous protrusion. The dilatation and diverticulum formations were seen to extend to the upper ends of the main bronchi, notably the left. Moreover, cylindric and sacculated bronchiectasies were observed diffusely in both inferior lobes. The remaining bronchial tree was not represented.[2]

Tracheal diverticula can be divided in the following groups:

1. Those described by CHIARI, which are supposed to be congenital. They are always situated on the right side of the trachea at the site of the bipartition of the bronchial tree (AEBY). They always extend obli-

[1] Submitted for publication, Oct. 8th, 1947.

[2] Similar cases, demonstrated by bronchography, have been reported by MORLOCH & SCOTT, KARTAGENER & ULRICH, and KAHLSTROM.

quely down and outwards, and their shape is that of a short cylindr e tube. Are presumed to correspond to a rudimentary, extra, apic l bronchus. The structure of the walls corresponds to that of the tr i- cheal wall. As a rule these diverticula are symptom-free and obser- ved only accidentally (KAHLER, ARCE, STILBE).

2. Flask-shaped diverticula, generally with a narrow inlet. Are most often found in the central one-third of the trachea to the right on the borderline between the cartilaginous and the membranous portions close to the cartilage ends. May also be found in the bronchi, where they are then localized along the right side of the membranous wall (PRZEWOSKI). Are generally small, but may reach the size of a hen's egg. Are often multiple and contain as a rule viscid mucus. They are said not to be rare and easily discoverable by a special technique (DIETSCH). The trachea may be normal (ORTH, MORESCH), but is generally moderately dilated and atrophic with chronic inflammatory changes. These formations have been interpreted partly as cysts in the retrotracheal mucous glands (ROKITANSKY, DIETSCH, MORESCH) and partly as hernial protrusions of the tracheal mucous membrane (PRZEWOSKI). SIMMONDS collected 70 cases. None of these patients had symptoms during life. Other writers state, however, that this form is generally associated with chronic respiratory tract diseases. This type of diverticula has never been observed in children and must be regarded as acquired anomalies (MORESCH). The diverticula may be conceived to develop on account of retention of mucus in the paratracheal glands by chronic irritation of the latter, or to be mechanically conditioned, i. e. be due to increased intratracheal pressure (EPPINGER). CHOMZENKO has reported a case in which there was found a caseous gland close to the diverticulum. This writer holds, like PETIT, that a diverticulum may develop by ingrowth of the tracheal mucous membrane into a cavity occurring after drainage of a pus-filled gland.

3. Diverticulum-like, groove-shaped protrusions of the posterior tracheal wall, first described by ROKITANSKY. The diverticula are delimited by transverse, crescent-shaped, mucous membrane folds connecting the posterior cartilage ends. In cases of slight development they are localized only in the upper part of the membranous wall, just inferior to the cricoid cartilage. But if they reach a bigger size they may cover the entire posterior wall, the biggest being then localized above (PRZEWOSKI). At the same time there is seen a marked increase in the width of the trachea and an as a rule diffuse, more rarely circumscribed, dilation of the bronchial tree (PRZEWOSKI, KAHLSTROM, MORLOCH & SCOTT). The dilatation of the trachea is due mainly to the increase in the width of the membranous wall. The

Fig. 1.

Fig. 2.

changes here are characterized as atrophy of the elastic-muscular tissue. As causes of the atrophy are mentioned age, inflammation, mechanical factors, and primary deficient development of the elastic tissue. The diverticula are characterized partly as pulsion diverticula (Henke-Lubarsch, Czyhlarz), and partly as traction diverticula (Rokitansky) due to traction from hypertrophic mucous glands. The patients have all from their young days been troubled by respiratory tract diseases. Diffuse tracheobronchiectasies without diverticulum formation have been described by various writers (Kartagener & Ul-

RICH, BRENNER & KRAUTER, MOUNIER-KUHN). It is probably the same pathological process that underlies the development of this and the above groups of diseases, since transition forms have been described (OLMER, D., OLMER, J., VAGUE & GALLIAN) and the pathologico-anatomical changes are essentially alike. No clinical distinction can be made either between the two groups. Though congenital dilatation of the trachea has not been described, several writers regard this disease as a congenital malformation (because of the early onset of symptoms and the diffuse character of the disease) taking this as evidence in favour of the congenital nature of the bronchiectasies in some cases.

The case reported in this article illustrates this latter form of diverticulum formation.

SUMMARY

Report on one instance of multiple tracheal diverticula revealed by bronchography. A study is made on earlier literature on this subject, and the possibility of congenital genesis in certain conditions of bronchiectasis is discussed.

ZUSAMMENFASSUNG

Es wird über einen Fall von mittels Bronchographie nachgewiesenen, multiplen Tracheadivertikeln berichtet. Das bisherige, diesbezügliche Schrifttum wird durchgenommen und die Möglichkeit eines angeborenen Auftretens gewisser Bronchiektasien erörtert.

RÉSUMÉ

Relation d'un cas de diverticules multiples de la trachée, mis en évidence par bronchographie. L'auteur passe en revue la bibliographie antérieure du sujet, et discute de l'origine congénitale possible de certaines bronchectasies.

REFERENCES

ACRE, J. M. D.: J. of Thoracic surg. 1942—43, 12: 638.
BRENNER, F. & S. KRAUTER: Wiener Klin. Wochschr. 1938, 51: 896.
CHIARI, O.: Chir. des Kehlkopfes und der Luftröhre (N. D. Chir. 19) 1916.
CHORUZENKO, T.: Zeitschr. für Hals-, Nasen- u. Ohrenheilk. 1928, XIX: 537.
v. CZYHLARZ, E.: Centralblatt für allg. Path. u. path. Anat. 1897, 8: 721.
HENKE, F. a. LUBARSCH, O.: Handbuch der spez. path. Anat. u. Hist. 3. 1: 301 a. 32.
KAHLER, O.: Monatsschr. f. Ohrenheilk. 1911, 45: 86.
KAHLSTROM, S.: Med. Bull. and the Vet. administr. 1941, 18, 2: 218.
KARTAGENER, M. a. ULRICH, K.: Schweizer. Med. Woch.; 1940, 21, 2: 1266.
MORESCH, R.: Wiener Klin. Wochschr. 1908, s. 824.
MORLOCH, H. and SCOTT, A.: Lancet, 1933, 11: 236.
MOUNIER-KUHN: Lyon Médicale, 1932, 11: 106.
OLMER, D., OLMER, J., VAGUE, S. a. GALLIAN, J.: La presse méd. 1939, 47: 272.
PRZEWOSKI, E.: Arch. für Lar. u. Rhin. 1898, 8: 422.
ROKITANSKY, C.: Lehrbuch der patol. Anatomie, 1861, 3: 6, 7, 11.
STILBE, E.: J. of Anatomy, 1929—30, 64: 62.

FROM THE EÖTVÖS LORÁND RADIUM AND ROENTGENINSTITUT, BUDAPEST, HUNGARY
(PHYSICIAN-IN-CHIEF: DR. B. WALD)

CONTRIBUTIONS ON THE ROENTGENOLOGY OF THE LEFT AURICLE[1]

by

Dr. *B. Wald*

All radiographic features depend on the anatomical and radiophysical properties of the organs and tissues. Because of the uniform absorption of roentgen rays by the heart its fluoroscopic appearances correspond with the surface of the organ. However one part of the cardiac surface is limited by the lungs i. e. by an organ having a lower absorptive capacity than that of the heart, while another part is contiguous with the mediastinum and the diaphragm i. e. with organs having much the same absorptive coefficients. Therefore on fluoroscopy only that surface of the heart adjacent to lung tissue is depicted. Thus the borderline of the heart shadow is formed by those sections of the surface which are, while having a common borderline with the lungs, passed by tangential rays of the whole beam employed.

It may therefore be inferred that only the walls of the left auricle that are adjacent to the lungs can be rendered visible fluoroscopically.

It has been shown by anatomical examination that it is the posterior wall of the left auricle and the exterior wall of its appendage which take part in forming the heart surface. First the fluoroscopic representation of the exterior wall of the left auricular appendage should be dealt with.

The left auricular appendage anatomically projects to the left and forward filling the angular space between the pulmonary artery and the left ventricle and partially surrounds the first part of the pulmonary artery. Its exterior wall is over its whole course, adjacent to the mediastinal surface of the left lung and so its plays a part in forming the left border of the middle shadow. This border of the left auricle is visible in postero-anterior fluoroscopy and also in the

[1] Submitted for publication, Sept. 15, 1947.

left and in the right anterior oblique examinations up to an obliquity of 15°—30° and about 45° respectively. The outline constituted by the left appendage is spoken of as the 3rd arch or the lower part of the second arch by authors who distinguish 4 or 3 parts in the left contour. In my opinion this division should not pass without some criticism. The borderline of the left appendage forms an arch allowing its limitation both upward and downward rather infrequently. The same holds true of the pulmonary artery both displaying a straight border more often than a curved one. For this reason most authors mention the border of the pulmonary artery and that of the left appendage together under the term »second arch». In these cases the second arch cannot be distinguished from the third one formed by the left ventricle except by a change in their course, an angular deviation, forming the so-called »heart taille». According to this conception this angle is formed by the borderline of the left appendage and the left ventricle. Anatomical and roentgen ray examinations demonstrating a clear distinction between the pulmonary and the appendage borders, through the curved course of both, do, however, disprove this conception proving that the course of the appendage coincides with that of the ventricle rather than that of the pulmonary artery. Thus the angle called »heart taille» is formed not by the appendage and the ventricle but by the appendage and the pulmonary artery. It is therefore fair to state that in cases of the trisected left contour, the border of the left appendage coincides with the upper part of the third arch rather than with the lower part of the second arch. Thus the second arch is formed by the pulmonary artery alone whereas the third by the appendage and the ventricle together.

In cases of mitral heart failure always involving dilatation of the left auricle the appendage may be dilated as well. This dilatation is however rarely sufficient to bring about an alteration, of the appendage border by rendering it prominent like an arch. The old concept that the most essential factor of mitral configuration i. e. the abolition of the heart taille is due to the dilatation of the appendage has not been proved by recent investigations. This may be seen also by kymography. Mitral configuration is mainly due to the left rotation of the heart and the dilatation of the right ventricle. The fact that vanishing of the heart taille was, by earlier authors, attributed to the dilatation of the left appendage was found to be due to an incorrect division of the left contour of the middle shadow. Those authors who sought for the border of the appendage in the lower part of the second arch seemed to assume that its projections might fill up the angle formed by the second and third arches. Actually however if

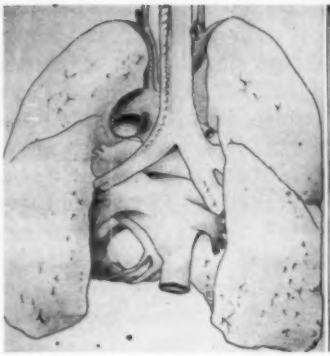


Fig. 1.

Fig. 2.

the appendage border were to form the upper part of the third arch its projection would tend to increase and not to abolish the angle.

Dilatation of the left appendage — an infrequent occurrence — can rarely be demonstrated on postero-anterior fluoroscopy. This is very likely due to the sinistro-rotation of the heart and almost constant concomitant of mitral heart desease. The left appendage is rotated backward in this condition and so its border is displaced from the left border of the middle shadow. Therefore, dilatation of the left appendage should, if presented all, be demonstrated by Bordet's method: an examination in the right anterior oblique position at an angle of 40°—45°. In some of my cases the projection of the upper part of the left contour could be demonstrated by this method.

With regards to the posterior wall of the left auricle (Fig. 1.) this is formed by two pouches corresponding to two pulmonary veins and the wall part situated between them called torus oesophagus. It is somewhat triangular in shape with the apex directed caudually. The upper part of the triangular surface is continuous on both sides with the walls of the pulmonary veins, the lower part fuses with the wall of the inferior vena cava (right auricle) on the right side and with the wall of the left ventricle on the left side.

Regarding the radiological appearances of the posterior wall of the left auricle the question to be examined is whether the basic requirements are fulfilled by its being intimately and directly related to the medial surface of the lung or not. To answer this question the intrathoracic anatomical relation should be studied. There are cross sections of the thorax which demonstrate the true relationships very well. That made by Pernkopf (Fig. 2.) represents the thoracic level

at the 8th dorsal vertebra. In this section the posterior aspect of the left auricle is found in its greatest lateral extension. It may be stated at once that the posterior aspect of the left auricle has at this level, where it is broader than anywhere, no contact with the mediastinal aspect of the lung. In the deeper layer of PERNKOPF's sections the extension of the posterior surface of the left auricle rapidly decreases. There is, however, no tight contact between the auricular surface and the lung at these levels. The right lung covers the surface of the vena cava, the left lung that of the left ventricle while neither of them reaches the narrowing left auricle.

This anatomical datum tells us — in the language of roentgenology — that the posterior aspect of the left auricle is inaccessible to direct fluoroscopic examination.

This statement concluded from anatomy is in sharp contrast to the claims almost invariably read in the textbooks on roentgenology. The textbooks hold that fluoroscopy done in the first oblique plane forming an angle of more than 30° with the sagittal plane, the right border facing the vertebral column of the cardiac shadow is formed by the left auricle. No doubt the posterior aspect of the left auricle is meant since on fluoroscopy done at any angle in the first oblique direction the auricle in part participates in forming the heart surface, the left appendage cannot be taken into consideration.

The contradiction between the conclusions drawn from anatomy and from the statements of the textbooks could be brought into accord by assuming that the conditions of the roentgenological appearances of the left auricle are not identical in the living and the dead. It may be realised that the topographical conditions being partly due to functional influences exerted by breathing and circulation, which also influence intra-thoracic pressure, are so different that the posterior surface of the left auricle may come into contact with the mediastinal aspect of the right lung in the living thus forming the borderline of the middle opacity at some angle in the first oblique position.

Of course it is impossible to solve this problem by anatomical examinations in the living, although an attempt should be made by roentgenological analysis.

The inference stating that the posterior aspect of the left auricle cannot be seen by fluoroscopy has been drawn from a cross section figure of PERNKOPF. It is easy to state from this figure, that the part of the left auricle capable of coming into an intimate contact with the mediastinal surface of the lung, provided such contact is possible, cannot be other, than its retrohilar part; a contact between the prehilar lung surface and the posterior aspect of the left auricle would

mean too great difference between living and post mortem topography.

Taking this fact into consideration one will be able to answer the question put above whether the posterior aspect of the left auricle can be represented by fluoroscopy in living normal individuals. One has only to establish by fluoroscopy whether the right border line of the shadow seen in the various first oblique position is situated in front of or behind the hilus. If a fluoroscopic direction can be found during sinistro-rotation in which the right heart contour coincides with or is displaced to the right of the shadow of the right hilus then the right border line of the middle shadow has at this angle of rotation been constituted by the retro-hilar lung surface thus it is due to the left auricle. If the right border is, during the whole rotation invariably found to the left of the hilus then no doubt will remain that the border is in all projections due to the right auricle situated in front of the hilus.

The problem could be solved by observations on the relations of the right hilus to the right border of the middle shadow on rotation to the left. I found that the right border was, in all projections, under the normal and morbid conditions to the right of the hilus. The observation of the right hilus is often difficult to visualise fluoroscopically. Up to about 45° its projection coincides with that of the vertebral column and is thus obscured. On rotation over 45° it is projected into Holzknecht's space where its shadow becomes confluent with shadows of other opaque organs in this vicinity. The observation of hili containing calcified foci anteriorly was considerably less difficult because the varying correlation of the calcified masses to the right border could be studied. Such observation demonstrates clearly that the right border is, in all projections, found by the right auricle situated in front of the hilus. (Fig. 3.)

Commencing with this observation we have to revise the conception of the textbooks with regard to the right cardiac contour. It is, however, of interest to examine the origin of this misconception universally adopted by all textbooks. The error may be attributed to two factors. First the radiographic appearances of the cardiac outline have not been carefully examined by the authors. This is illustrated in Zdansky's excellent monograph in which the author attempts to show the demonstrability of the posterior aspect of the left auricle on the right contour obtained in the first oblique position by utilising the same cross section of Pernkopf which we use to prove that the same part of wall was not demonstrable. The basic condition of demonstrability — that a contour cannot be formed except by a part contiguous with pulmonary tissue — has not been considered by Zdansky.

Fig. 3.

Fig. 4.

Fig. 5.

The second factor in the error arises from pathological cases. It is commonly known that in heart diseases attended by dilatation of the left auricle the right contour visualised in the first oblique position, especially in its upper part, exhibits a deaper curving and its arch projects deaper against the vertebral column than in normal cases thus narrowing HOLZKNECHT's space. (Fig. 4.) It is reasonable to assume, that this change is due to the dilatation of the left auricle and the changed contour in its projection. This may lead to the faulty statement that this contour is due to the left auricle under normal conditions as well.

Here a new problem arises that of the pathological dilatation of the left auricle. Numerous observations indicate that this condition leads to a change in the right contour seen fluoroscopically in the first oblique. This prominence of the posterior wall of the left auricle has been accepted as being due to pathological dilatation of the said chamber. The explanation would appear to be erroneous because the posterior aspect of the auricle cannot be visualised fluoroscopically and secondly the changed right contour as can be proved by rotation lies in front of the hilus. The same is also proved of the cases in which the border of the dilated left auricle, even on postero-anterior fluoroscopy, contributes to the right border which is now formed only by the right auricle alone. It can be shown in these cases that both contours correspond to prehilar parts of the cardiac surface.

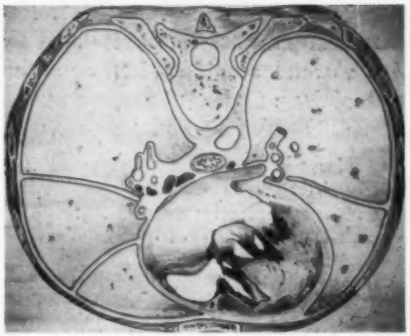


Fig. 6.

Since the alteration of the right contour is not proved to the prominent wall of the left auricle we must search for another explanation. One may suppose that it is due to dilatation of the right auricle solely, but several factors disprove this supposition. Firstly the pathological projection of the right contour can frequently only be seen in the first oblique position. The dilatation of the right auricle should, however, be best visualised in the postero-anterior position because the auricle has a free space laterally in which to dilate. Secondly the characteristic change dealt with refers not to the whole contour but only to its upper part. Not unfrequently an angle is formed by the the prominent upper part and the normal lower part (Fig. 5). This angle appears also in the oblique position when it is conspicuous in the cases in which the characteristic projection is clearly seen on sagittal examination. This opposes the view that the change is caused by the right auricle unless an aneurismal dilatation is inferred, an inference that is not supported by morbid anatomical data.

The change of the right contour seen in the first oblique position is therefore not due to the right auricle, but a second possibility presents itself. The left auricle dilates not only backwards, but also forwards in the direction of the inter-auricular septum. During this the auricle becomes partially prehilar in situation (Fig. 6) and in this way the left auricle dilates also laterally and brings about the projection of the prehilar part of the cardiac surface so that its posterior part is accessible to fluoroscopy. This is the projection seen at the upper part of the right contour only because the left auricle does not extend as low down as the inferior limit of the right auricle. The same projection appears in some instances on sagittal fluoroscopy at the upper part of the right contour if it extends laterally beyond the border of the right auricle. This mechanism gives simultaneously a satisfactory explanation for the double arch of the right contour. Ultimately the dilatation of the left auricle can really be demonstrated on first oblique fluoroscopy. It is, however, not the projection of its posterior wall that is visualised as is generally believed but is due to the forward and lateral expansion.

Projection of the posterior wall can only be demonstrated by in-

direct methods such as the indentation and backward displacement of the oesophagus. The details of this phenomenon need not be discussed here because nothing can be added to the textbook descriptions.

SUMMARY

Direct roentgenological representation of the posterior wall of the left auricle cannot be afforded, because this portion has no surface of contact with the air-containing lung. The author demonstrates by means of both anatomic and roentgenological investigations, that the outline of the heartshadow on the right, when confined to the 1st oblique diameter, is always formed, in whatever projection, by the right auricle, and not — as is usually admitted — by the left one. The upper portion of the right border of the heart-shadow in the 1st oblique diameter may protrude, should pathological enlargement of the left auricle occur. Evidence is given that discloses such protrusion not to be caused by alterations located to the posterior wall of the left auricle, but to be conferred by an expansion of this part of the heart directed ventrally and to the right.

ZUSAMMENFASSUNG

Die hintere Wand des linken Vorhofes ist der direkten röntgenologischen Darstellung nicht zugänglich, weil sie keine Berührungsfläche mit der kontrastgebenden lufthältigen Lunge besitzt. Es wird an Hand anatomischer und röntgenologischer Beweise dargelegt, dass die rechte Kontur des Herzschattens im 1. schrägen Durchmesser unter normalen Verhältnissen in allen Projektionen nicht — wie allgemein angenommen — durch den linken, sondern immer durch den rechten Vorhof gebildet wird. Bei pathologischer Erweiterung des linken Vorhofes kann es im 1. schrägen Durchmesser zu einer Vorwölbung des oberen Teiles des rechten Herzschattenrandes kommen. Es wird nachgewiesen, dass diese Vorwölbung nicht durch den veränderten hinteren Wand des linken Vorhofes, sondern durch die nach ventral und rechts gerichtete Expansion dieses Herzteiles gebildet wird.

RÉSUMÉ

La paroi postérieure de l'oreillette gauche échappe à la représentation radiologique directe, parce qu'elle n'a pas de surface de contact avec le poumon et son contenu gazeux qui crée le contraste. Avec preuves anatomiques et radiologiques à l'appui, l'auteur expose que dans le diamètre oblique gauche, et dans des conditions normales, les contours droits du cœur, quelle que soit la projection, ne sont pas ceux de l'oreillette gauche — comme on l'admet généralement — mais toujours ceux de l'oreillette droite. Lors d'une dilatation pathologique de l'oreillette gauche il peut se produire un bombement de la partie supérieure de l'ombre du bord droit du cœur, dans le diamètre oblique gauche. L'auteur démontre que ce bombement n'est pas dû à une modification de la paroi postérieure de l'oreillette gauche, mais à l'expansion en direction ventrale et droite de cette partie du cœur.

AUS DER OTOL. ABTEILUNG (CHEFARZT: DR. MORARD) UND DEM RÖNTGENINSTITUT (CHEFARZT: PRIVATDOZENT DR. E. A. ZIMMER) DES KANTONSSPITALS FRIBOURG, SCHWEIZ

ZUR RÖNTGENOLOGIE DES DUCTUS THYREOGLOSSUS PERSISTENS[1]

von

W. Güntert

Der *Ductus thyreoglossus* ist bekanntlich eine normale embryonale Bildung, die im Zusammenhang mit der Schilddrüsenentwicklung auftritt. His (1) konnte ihn schon bei sehr jungen Embryonen beobachten. Er obliteriert aber gewöhnlich recht früh im fötalen Leben und verschwindet schliesslich. Ueberreste in Form solider Epithelstränge können jedoch als *Tractus thyreoglossus* selbst beim Erwachsenen noch gefunden werden. — Infolge einer *Entwicklungsstörung*, deren Ursache wir noch nicht kennen, bleibt zuweilen die Obliteration des embryonalen Zungen-Schilddrüsen-Ganges aus. Wir bezeichnen diese Hemmungsmissbildung als *Ductus thyreoglossus persistens*. Er zerfällt anatomisch in zwei Abschnitte: Der *Ductus lingualis* ist dem Pathologen eine recht bekannte Erscheinung. Morgagni (2), der als erster auf dieses Gebilde aufmerksam geworden ist, berichtet, dass er es in 26 von 50 untersuchten Fällen nachweisen konnte. Nach den Angaben neuerer Autoren (3, Wegelin, in Henke-Lubarsch) findet man verhältnismässig oft einen Gang von 1—2.5 cm Länge, der sich, ausgehend vom *Foramen caecum linguae*, entlang der Medianebene in Richtung auf das Zungenbein zwischen die Zungenmuskulatur einsenkt. Nicht selten erreicht dessen blindes Ende das Niveau des Zungenbeines. — Erheblich seltener beobachtet man dagegen, dass sich der Ductus thyreoglossus durch das Zungenbein hindurch fortsetzt und absteigt bis in die Gegend des Lobus pyramidalis der Schilddrüse. Dieses zweite, tiefere Gangstück wird als *Ductus thyreoideus* beschrieben.

Ein persistierender Ductus thyreoglossus macht seinem Träger gewöhnlich keinerlei Beschwerden. Er wird deshalb oft während längerer Zeit nicht beachtet. Erfolgt jedoch vom Foramen caecum her

[1] Bei der Red. am 15. VIII. 1947 eingegangen.

eine Infektion, so kann sich eine *Entzündung* an der Zungenbasis entwickeln. Seltener ist es, dass Teile dieser Missbildung zum Ausgangspunkt *maligner Tumoren* werden. (4, CLUTE and CATELL). — Eine entzündliche oder maligne Schwellung verursacht dann ihrerseits verschiedenartige *funktionelle Störungen*. So berichtet z. B. STRAUCH (5) von einem chronischen, gegen jede Therapie resistierenden Husten. Nach BAUMGARTNER (6) kommt es zu Sprachstörungen, Atem- und Schluckbeschwerden. GILMAN (7) nennt die gleichen Erscheinungen und fügt noch Zirkulationsstörungen hinzu. — Schliesst sich das Foramen caecum nach der Infektion durch Verkleben der entzündeten Wände, so kann sich Sekret oder Eiter im untern Teil des Ganges ansammeln, sodass sich infolgedessen der Ductus zu einer *Zyste* erweitert (8, SISTRUNK). Derartige Retentionszysten suchen sich zu entleeren: entweder wird das Foramen caecum durch den steigenden Innendruck wieder aufgesprengt oder es kommt zur Spontaneröffnung der Zyste nach aussen unter Bildung einer *medianen Halsfistel*.

Ein Tumor oder ein Abszess an der Zungenbasis oder im medianen Halsgebiet, eine Halsfistel usw., sind die Zustände, welche die Patienten veranlassen, den Arzt zu konsultieren. Uebereinstimmend berichten fast alle Autoren, dass die *Diagnose* dieser Affektionen als *Derivate eines Ductus thyreoglossus* zwar nicht sehr schwer zu stellen sei; da aber bei solchen Fällen ein persistierender Ductus thyreoglossus verhältnismässig selten die Krankheitsursache ist, so denkt man zuerst an eine Reihe anderer ursächlicher Möglichkeiten. Ein Lipom, Atherom, Lymphom, ein tbc. Abszess oder eine Dermoidzyste gehören zu den Krankheitsbildern, die differentialdiagnostisch in Frage kommen. (9, v. HEREPEY-CSAKANYI). Die Diagnose wird erheblich erleichtert durch die *röntgenologische Untersuchung*. Man versucht zystische Tumoren mittels percutaner Punktion oder vom Foramen caecum her zu entleeren und injiziert dann ein Kontrastmittel. Bei Fistelbildungen wird eine Fistelfüllung vorgenommen. Eine seitliche und eine a.—p. Aufnahme des Unterkiefergebietes und der vordern Halsregion genügen meistens zur Abklärung des Leidens (10, WANGENSTEEN).

In der vorliegenden Arbeit sind die wenigen, bisher in der Literatur erschienenen Röntgenbilder des Ductus thyreoglossus persistens und seiner Derivate zusammengestellt. Anhand einiger typischer Krankengeschichten wird die Bedeutung der Röntgenuntersuchung gezeigt. Schliesslich wird ein Fall vorgestellt, der im Kantonsspital F r i b o u r g zur Beobachtung gelangte. —

Um für die morphologische Klassierung der Bilder eine Richtlinie zu gewinnen, müssen wir uns zunächst mit den Tatsachen der Embryologie und Teratologie näher bekannt machen.

Embryologie und Teratologie

Die Entwicklung der Schilddrüse beginnt in der dritten Embryonalwoche. In der *Area interbranchialis,* nahe der Grenzfurche zwischen dem entodermalen und dem ektodermalen Anteil des Zungenepithels setzt eine Wucherung des Entoderms ein. Es bildet sich zunächst ein unpaarer, medianer Höcker, der als *Tuberculum thyreoideum* bezeichnet wird. Von seiner Spitze aus senkt sich sodann das Epithel in das mesenchymale Gewebe ein. His (11) beschreibt beim 4 mm langen Embryo die Schilddrüsenanlage als *unpaares Epithelbläschen,* das cranial von der ebenfalls noch unpaaren Lungenanlage liegt. Die Schilddrüsenanlage wächst dann in die Breite und in die Tiefe. Dabei kommt sie mit dem Truncus arteriosus des Herzens in Berührung. Mit ihm zusammen macht sie eine caudale Verlagerung durch. Sie bleibt aber mit der Mundhöhle noch kurze Zeit in offener Verbindung durch einen epithelialen Schlauch den *Ductus thyreoglossus.* Beim Embryo von 7 mm Länge lässt sie sich als *zweiteiliges Bläschen* erkennen, das einen unpaaren, *epithelialen Stiel* zur Zungenoberfläche entsendet. Der Ductus thyreoglossus ist also in diesem Zeitpunkt schon grösstenteils obliteriert. Das *Foramen caecum* markiert zeitlebens den Ausgangspunkt der Schilddrüsenentwicklung in der Mitte des V-förmigen *Sulcus terminalis linguae,* der die beiden Anlagebezirke des Zungenepithels gegen einander abgrenzt. Beim 14 mm langen Embryo weist der Ductus thyreoglossus normalerweise kein Lumen mehr auf, ist aber noch als zusammenhängender Epithelstrang erkenntlich. (12, Patzelt). Man spricht nun vom *Tractus thyreoglossus.* Dieser zerfällt innert kurzer Zeit, sodass beim Embryo von 17 mm Länge nur noch einige Reste erhalten sind.

Die Verhältnisse in der Zungenbeingegend bedürfen noch der Erwähnung. Zur Zeit des Schilddrüsen-Descensus ist das *Zungenbein* noch gar nicht vorhanden. In der 5. Embryonal-Woche legt es sich an und wächst dann von der Dorsalseite her gegen den Tractus thyreoglossus zu. Es führt zuweilen seine vollständige Unterteilung herbei, oder die Ueberreste des Ductus thyreoglossus werden im Laufe der weitern Zungenbeinentwicklung von Knochengewebe umschlossen (13, Wenglowski).

Wie aus dieser embryologischen Darstellung ersichtlich ist, lassen sich alle mit der Schilddrüsenentwicklung zusammenhängenden *Missbildungen* auf sehr frühe embryonale Störungen zurückführen. Wenn sie auch oft erst im adulten Leben dem Träger bekannt werden, so sind sie doch im eigentlichen Sinne »congenital».

Entlang dem ganzen Abstiegsweg der Schilddrüse können Epithelreste erhalten bleiben, aus denen sich zuweilen *accessorische Schild-*

drüsen entwickeln. Die Existenz einer *Glandula hyoidea*, d. h. einer Schilddrüse innerhalb des Zungenbeines, ist also leicht verständlich. RABL (14) hat sie beim Meerschweinchen mehrfach nachgewiesen. Beim Menschen ist nach dem gleichen Autor eine *Glandula supra-hyoidea* häufiger.

Es scheint aber im Grossen und Ganzen eher selten, dass liegengebliebene Reste des Ductus thyreoglossus die Potenz zur Bildung funktionstüchtiger Nebenschilddrüsen haben. Häufiger entwickeln sich daraus atypisch gelagerte *Schleimdrüsen*. Besonders benannt ist eine Gruppe von Drüsen, die vom Ductus lingualis ausgehen, die sog. *Bochdalek'schen Schläuche*.

Nach NEUMANN (15) gehören die Bochdalek'schen Schläuche zu den klassischen Ausgangspunkten der *Ranula*. Darunter versteht man bekanntlich ein *zystisches Gebilde* an der Unterfläche der Zunge oder zwischen dem Frenulum linguae und der Spitze des Unterkiefers. *Retentionszysten* können von allen Schleimdrüsen entlang dem Tractus thyreoglossus oder von den accessorischen Schilddrüsen ausgehen. Sie entleeren sich auf dieselbe Art wie die früher geschilderten Zysten, die auf infektiöser Grundlage entstehen, nämlich entweder durch Fistelbildung (congenitale Halsfistel) oder indem das Foramen caecum aufgesprengt wird. — Es ist eine Tatsache, dass Zysten des Ductus thyreoglossus über dem Zungenbein viel seltener vorkommen als infrahyoid. Man beobachtet zuweilen ein Absinken suprahyoider Zysten entlang dem Abstiegsweg der Schilddrüse bis auf Höhe des Zungenbeines. Infolge der besondern genetischen Beziehungen in dieser Region erfährt hier der Descensus einer Zyste einen Stop oder doch ein Abweichen vom vorgezeichneten Weg (GILMAN).

Wegen diesen genetischen Beziehungen zwischen Zungenbein und Tractus thyreoglossus entfernt SISTRUNK (16) bei der Exstirpation von Ductus-thyreoglossus-Zysten immer auch den mittleren Zungenbeinabschnitt, um allfällige Rezidive von intrahyoiden Gangresten her auszuschliessen.

Es bleibt nun noch übrig, auf die sehr umstrittenen *lateralen Schilddrüsenanlagen* hinzuweisen. Dabei stütze ich mich zumeist auf die Angaben von HIS. — Die paarigen seitlichen Schilddrüsenanlagen entwickeln sich aus jenen Teilen des primären Rachenbodens, die links und rechts neben dem Kehlkopfeingang liegen *(Sinus piriformis)*. Beim Embryo von 10 mm Länge erfolgt hier eine Einstülpung des Epithels, sodann eine Abschnürung der paarigen Epithelbläschen, die beim 12 mm langen Embryo schon recht weit fortgeschritten ist. Beim Embryo von 13.8 mm Länge haben sich die seitlichen Schilddrüsenanlagen mit der mittleren zusammengelagert. — Die Arbeiten von WENGLOWSKI liessen die Bildung lateraler Schilddrüsenanlagen als re-

sicnert erscheinen. Neuere Autoren sprechen sich indessen gegen diese Auffassung aus. So sagt DELSERIES (17), die lateralen Anlagen seien nicht am definitiven Aufbau der Schilddrüse beteiligt, sondern ergäben die sog. *postbranchialen Körperchen.* In diesem Fall müsste der Befund von SNOKE (18) in einem andern Sinn gedeutet werden, trotzdem er sich so leicht in das Entwicklungsschema von WENGLOWSKI einfügt. (Siehe unten: Fall Nr. 5, von SNOKE.)

Röntgenologie

Nach Füllung mit einem geeigneten Kontrastmittel lassen sich die gangförmigen und zystischen thyreogenen Missbildungen röntgenologisch darstellen. Die Beurteilung der Röntgenbilder stützt sich auf die eben geschilderten embryologischen und teratologischen Tatsachen. Dabei ist es wichtig, zu unterscheiden, ob die congenitale Missbildung in ihrer ursprünglichen Form vorliegt, oder ob sie eine sekundäre Veränderung durch Infektion oder maligne Entartung erfahren hat.

Nach dem bisher Mitgeteilten lässt sich etwa folgende *Einteilung der Röntgenbefunde thyreogener Missbildungen* geben:

I. Thyreogene Missbildungen ohne sekundäre Veränderungen:

1. Nach Störungen in der Obliteration des *Ductus thyreoglossus* kann auftreten:
   a) ein *Ductus lingwalis persistens,* wenn die Obliterationsstörung nur den suprahyoiden Anteil des Zungen-Schilddrüsenganges betroffen hat.
   b) ein *Ductus thyreoglossus persistens,* wenn die Obliterationsstörung die ganze embryonale Gangbildung betroffen hat.
2. Nach unvollständiger Rückbildung des *Tractus thyreoglossus,* d. h. wenn einzelne Epithelreste entlang dem Descensus liegen geblieben sind, können sich entwickeln:
   a) *Schleimzysten,* ausgehend von accessorischen Schleimdrüsen. Als besondere Form ist die *Ranula* anzuführen.
   b) *Schilddrüsenzysten,* ausgehend von accessorischen Schilddrüsen. Besonders ist auf die *Zungenbeinzysten* hinzuweisen, die von intrahyoiden Resten des Tractus thyreoglossus ausgehen.
3. Nach Störungen in der Obliteration der *lateralen Schilddrüsenanlagen* entstehen paarige, von den Sinus piriformes ausgehende, gegen das Zungenbein hin konvergierende Gangbildungen.

II. Thyreogene Missbildungen mit sekundären Veränderungen:

1. Nach *Obliterationsstörungen* und späterer *Infektion* können sich bilden:
   a) *inkomplette, innere Fisteln,* ausgehend von einem infizierten Ductus thyreoglossus. Dabei ist das Foramen caecum zugleich Fistelöffnung.
   b) *Ductus-thyreoglossus-Zysten* im engern Sinne: in jeder Höhe zwischen dem Foramen caecum und der Schilddrüse auftretend, sekundär ev. auch tiefer als die Thyreoidea, bis zum Sternum absinkend.
   c) *Mediane Halsfisteln,* inkomplette oder komplette, aus einem infizierten Ductus thyreoglossus entstehend.
   d) Inkomplette oder komplette *Halsfisteln,* die von infizierten, persistierenden lateralen Schilddrüsenanlagen herrühren.
2. *Maligne Tumoren* können von irgendwelchen Teilen eines persistierenden Ductus thyreoglossus ausgehen.

Es ist mir nicht gelungen, alle in dieser Uebersicht genannten thyreogenen Missbildungsformen durch Röntgenbilder zu illustrieren. Aber das Studium der vorhandenen Aufnahmen und die Durchsicht der pathologisch-anatomischen Literatur lassen wohl den Schluss zu, dass auch die fehlenden Fälle früher oder später gefunden werden. Möglicherweise sind unter den mir nicht erreichbaren Bildern noch solche, die eine Lücke in meiner Zusammenstellung ausfüllen könnten. Jedenfalls haben Smokwina (19), Capua (20) und Jones (21) Röntgenbilder von Ductus-thyreoglossus-Derivaten veröffentlicht. Die Aufnahmen, welche v. Gangelen (22) an der Versammlung der Holländischen Vereinigung der Hals-, Nasen- und Ohrenärzte 1931 in Amsterdam zeigte, stellen wahrscheinlich einen Parallelfall zu dem unsrigen dar.

Ein persistenter Ductus lingualis oder thyreoglossus ohne sekundäre Veränderungen ist meines Wissens bisher nicht röntgenologisch dargestellt worden, wohl deshalb, weil deren Träger infolge der absoluten Beschwerdefreiheit nichts von ihrer Missbildung merken. — Röntgenaufnahmen von Schleimzysten thyreogener Herkunft oder von atypisch gelagerten Schilddrüsenzysten sind mir ebenfalls nicht bekannt. Die bisher publizierten Röntgenbilder stammen ausnahmslos von solchen Patienten, deren thyreogene Missbildung im adulten Leben durch Infektion verändert wurde. — Es folgen nun die Krankengeschichten und Röntgenbildpausen einiger Fälle:

Fig. 1 a.

Fig. 1 b.

Fig. 1 a. A.-p.-Aufnahme einer mit Lipiodol gefüllten Zyste des Ductus lingualis.
Fig. 1 b. Seitliche Aufnahme der gleichen Zyste.
Fig. 2. Zyste des Ductus lingualis mit temporärer innerer Fistel am Foramen caecum.
Fig. 3. Zyste des Ductus thyreoideus mit teilweise persistierendem Ductus lingualis. Inkomplette äussere Halsfistel.

Fig. 2.

Fig. 3.

1. *Zyste des Ductus lingualis mit temporärer innerer Fistel am Foramen caecum. (Fig. 1 + 2)*

Fall Nr. 1 (Pat. L. M., Kantonsspital Fribourg): Im Febr. 1944 Abscess an der Zungenbasis mit starker Eiterung. — Wärmeapplikation und Röntgenbestrahlung. — Seither mehrere Recidive, wobei auch Schluckbeschwerden auftraten. — Im Okt. 1945 Untersuchung durch Dr. MORARD im Kantonsspital Fribourg, Anfertigung von Röntgenaufnahmen, die hier wiedergegeben sind (Fig. 1 a, 1 b). Diagnose: Zyste des Ductus lingualis. Exstirpation, Heilung.

2. *Zyste des Ductus thyreoideus, mit teilweise persistierendem Ductus lingualis. Inkomplette äussere Halsfistel. (Fig. 3)*

Fall Nr. 2 (v. HEREPEY-CSAKANYI): Haselnussgrosse Geschwulst in Höhe des Zungenbeines wird mit der Diagnose »Atherom« entfernt. Recidiv. Erneute Operation.

Recidiv. Röntgenaufnahme: Ductus-thyreoglossus-Zyste. Operation. Recidiv. Erneute Röntgenaufnahme: Gangbildung gegen die Zungenoberfläche sichtbar. Totalexstirpation. Heilung.

3. *Komplette, mediane Halsfistel, ohne Zystenbildung. (Fig. 4, 5)*

Fall Nr. 3 (SCHWEIZER, 23) (Fig. 4): Median gelegener Abszess am Hals sowie multiple kleinere Nebenabszesse werden gespalten. Reichlich sezernierende Fistel bleibt bestehen. Röntgenuntersuchung: Komplette, mediane Halsfistel, ausgehend von einem persistenten Ductus thyreoglossus.

Fall Nr. 4 (KINSELLA, 24) (Fig. 5): 21-jähriger Pat. mit medianer Halsfistel, die seit der Kindheit besteht. Klinische Untersuchung ergibt Ductus-thyreoglossus-Fistel. Röntgenbild bestätigt diese Diagnose.

4. *Erhalten gebliebene laterale Schilddrüsenanlage. (Fig. 6a, 6b)*

Fall Nr. 5 (SNOKE): 34-jährige Pat. hatte mit 14 Jahren recidivierende Schwellungen in der Submandibulargegend, einmal mit Eiterung. Incision und Versuch, eine Zyste zu entfernen. Nach 5 Jahren Spontaneröffnung einer Fistel, welche 14 Jahre persistierte. Erfolgloser Versuch einer Excision. Röntgenuntersuchung: Reste der seitlichen Schilddrüsenanlagen erhalten, reichen bis in die unmittelbare Nähe des Sinus piriformis. — Es sei hier nochmals daran erinnert, dass die Interpretation disese Falles im Hinblick auf die Embryologie sehr problematisch ist.

Fig. 4. Komplette mediane Halsfistel.

Fig. 5. Komplette mediane Halsfistel.

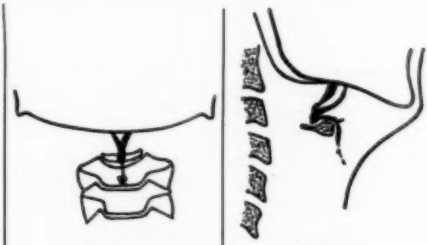


Fig. 6 a Fig. 6 b

Fig. 6 a, b. A.-p. und seitliche Aufnahme von erhalten gebliebenen lateralen Schilddrüsenanlagen.

Die Wiedergabe dieser Krankengeschichten beweist den bedeutenden *diagnostischen Wert der Röntgenuntersuchung bei Halsaffektionen unklarer Genese.* Man ist versucht, es als typisch zu bezeichnen, dass Patienten mit Ductus-thyreoglossus-Zysten unter einer falschen Diagnose behandelt werden, bis endlich das Röntgenbild die Abklärung des Leidens bringt. Das trifft nicht nur für die hier wiedergegebenen Fälle zu, sondern es könnten aus der Literatur noch manche Beispiele zitiert werden, die in gleicher Weise die Bedeutung der Röntgenuntersuchung dokumentieren. — COLP und KLINGENSTEIN (25), sowie HAEUSER

(2.) haben besonders darauf aufmerksam gemacht, dass die röntgenologischen Abklärungen der komplizierten Verhältnisse in der Zungenbeingegend für den Chirurgen recht wichtig sei. — WANGENSTEEN verlangt eine rasche röntgenologische Untersuchung aus Rücksicht auf den Patienten. Wenn die Diagnose frühzeitig gestellt wird, so kann auch sofort eine wirksame Behandlung eingeleitet werden. Das bedeutet für den Patienten eine wesentliche Verkürzung seiner Krankheitszeit. Besonders der Fall Nr. 5 (SNOKE) zeigt, dass die Forderung von WANGENSTEEN vollauf gerechtfertigt ist, sind doch nicht weniger als 20 Jahre verflossen vom Beginn der Erkrankung bis zur endgültigen Diagnosestellung und anschliessenden Heilung.

Nun ist die Frage zu studieren, mit welchen morphologischen Tatbeständen wir die *Röntgendiagnose der Ductus-thyreoglossus-Derivate* begründen können, und wie die Abgrenzung gegen andere Krankheitsbilder erfolgen kann. — Das *Röntgenbild* zeigt die Grösse, Form und Lage der Missbildung, die topographischen Beziehungen zur Umgebung, insbesondere zum Zungenbein und zum Foramen caecum, die Art der Begrenzung (ob scharf oder unscharf). Die *Durchleuchtung* kann zudem noch Aufschlüsse geben, ob vorhandene funktionelle Störungen, besonders Atem- oder Schluckbeschwerden mit der Missbildung in ursächlichem Zusammenhang stehen. — Alle diese Gesichtspunkte sind *differentialdiagnostisch* zu verwerten. Der Ductus thyreoglossus und seine Derivate lassen sich dadurch von andern pathologischen Höhlenbildungen des Halses abgrenzen:

1. Von einer *Abszesshöhle,* die sich beispielsweise aus einer Adenitis tbc. gebildet hat, unterscheidet sich eine Ductus-thyreoglossus-Zyste durch *absolut scharfe Begrenzung* des Röntgenschattens (WANGENSTEEN). Während aus einer Abszesshöhle das Kontrastmittel entlang den natürlichen Gewebsspalten in die Umgebung abfliessen kann, entweicht es aus einer epithelbekleideten Zyste nicht. — Differentialdiagnostische Schwierigkeiten können jedoch auftreten, wenn die Zyste sekundär, z. B. im Anschluss an einen entzündlichen Prozess, ihr Epithel verloren hat.

2. Eine *branchiogene Zyste* lässt sich in der a.—p. Aufnahme durch ihre laterale Lage erkennen. Die vom Ductus thyreoglossus ausgehenden Gebilde liegen immer in der *Medianebene.*

3. Von *Atheromen der Haut und Dermoidzysten* lassen sich die Derivate des Ductus thyreoglossus einerseits durch das *Punktat,* anderseits durch das Fehlen einer *topographischen Beziehung* zum Foramen caecum oder zum Zungenbein abgrenzen.

4. Zysten der *Bochdalek'schen Drüsen* gehören im weitern Sinne

auch zu den Derivaten des Ductus thyreoglossus. Die Ranula ist aber unter der Zunge auch visuell sichtbar.

5. Zysten der *Zungenspeicheldrüsen* sind paramedian gelegen und haben keine Verbindung mit dem Foramen caecum.

Wir fassen die *röntgenologischen Charakteristika* der Gebilde, die ihren Ursprung einem persistierenden Ductus thyreoglossus verdanken, zusammen:

1. Thyreogene Missbildungen liegen in der *Medianebene des Halses*. Das Niveau einer Zyste inbezug auf die übrigen Halsorgane ist dagegen nicht ausschlaggebend. Ductus thyreoglossus-Zysten können gefunden werden vom Foramen caecum an bis zum Sternum, wie Chemin (27) u. a. gezeigt haben.

2. Häufig lässt sich eine *topographische Beziehung* zum Foramen caecum oder zum Zungenbein oder zu beiden nachweisen.

3. Die *scharfe Begrenzung* des Röntgenschattens nach Kontrastmittelfüllung ist pathognomonisch für eine epithelbekleidete Zyste.

Die *Anfänge der Röntgenuntersuchung des Ductus thyreoglossus* liegen ungefähr 25 Jahre zurück. Shugyo und Takeda haben als erste in den Jahren 1920/22 die Röntgenstrahlen zur Untersuchung dieser Missbildung herangezogen. Während der Japaner Shugyo (28) eine solide Metallsonde in den Ductus einführte, um dessen Tiefe auf dem Röntgenbild zu messen und seine Beziehungen zur Umgebung festzustellen, verwendete Takeda (29) als Kontrastsubstanz eine Aufschwemmung von Bariumsulfat. Dem Prinzip nach war diese Methode — die Kontrastmitteldarstellung pathologischer Höhlenbildungen — damals nicht mehr neu. Sie gewährt viel exaktere Einblicke in die räumliche Ausdehnung (Zysten, Sinus, Verzweigungen) einer solchen Gangbildung, als die Methode von Shugyo. — Das Verfahren von Takeka ist denn auch im Wesentlichen bis heute beibehalten worden. Wir finden es neuestens in »Positioning in Radiography» von Clark (30) als Routineverfahren dargestellt, wobei aber an Stelle von Bariumsulfat das Jodöl als Kontrastmittel empfohlen wird.

Um 1920 hat Boss (31) zur Untersuchung einer Ductus-thyreoglossus-Zyste noch gewöhnliche Standard-Aufnahmen des Halses ohne Verwendung einer Kontrastsubstanz angefertigt. Mit deren Hilfe wurden die Halsorgane auf einen raumbeengenden Prozess untersucht. In dem beschriebenen Fall ergab aber das Röntgenbild »nicht die geringste Verdrängung der Trachea oder des Larynx» durch einen median gelegenen, ca. apfelgrossen, zystischen Tumor. Daraus ist der geringe Wert einer solchen Untersuchung ohne weiteres ersichtlich. Als Kontrolle vor einer Kontrastmitteldarstellung der thyreogenen

Missbildung hat diese Methode dennoch vielleicht eine gewisse Berechtigung.

Ueber die *Untersuchungstechnik* können etwa folgende Angaben gemacht werden:

1. Von den gebräuchlichen ältern und neuern *Kontrastmitteln* sind die meisten schon angewandt worden, um den Ductus thyreoglossus darzustellen, so die 10- und die 20 %-ige Lösung von Natriumjodid oder Natriumbromid, dann Aufschwemmungen von Barium, Wismut, etc., und in neuerer Zeit besonders Thorotrast und Jodöle. — Die Wahl des Kontrastmittels ist nicht ganz gleichgültig. Besteht eine komplette oder eine äussere inkomplette Fistel, also immer wenn eine Fistelöff-

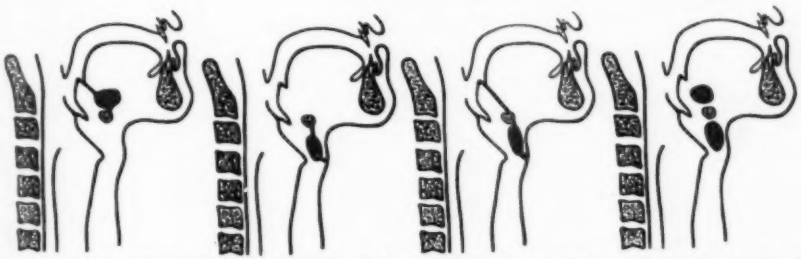


Fig. 7 a. Inkomplette innere Fistel.

Fig. 7 b. Inkomplette äussere Fistel.

Fig. 7 c. Komplette mediane Halsfistel.

Fig. 7 d. Zyste des Ductus thyreoglossus ohne innere oder äussere Fistelöffnung.

nung am Hals vorliegt (Fig. 7 b, 7 c), so eignet sich ein viscöses Kontrastmittel besser als ein dünnflüssiges. Bei Jod-Idiosynkrasie sollen die Jodöle gemieden werden. Statt diesen wäre etwa Bromipin oder Thorotrast zu verwenden. Besonders wenn nach dem klinischen Befund mit einem tiefen Sitz der Zyste zu rechnen ist, so dürfen nur solche Kontrastsubstanzen gewählt werden, die vom Körper sicher schadlos ertragen werden. Denn einerseits werden oft ganz beträchtliche Mengen zur Füllung dieser Hohlräume benötigt, anderseits ist weder eine rasche und vollständige Spontanentleerung zu erwarten, noch dürfte ein sauberes Absaugen des Kontrastmittels immer gelingen.

2. Der *Ort der Injektion* richtet sich nach den klinischen Erhebungen:

Die *inkomplette innere Fistel (Fig. 7 a)* macht eine Füllung vom Foramen caecum her nötig. Weil häufig Cholesterinkristalle in den Zysten enthalten sind (nach Bailey, (32) pathognomonisch), die vor

der Kontrastmittelfüllung entfernt werden müssen, so empfiehlt sich die Verwendung möglichst weitlumiger Kanülen. An Stelle von Punktionsnadeln wurden auch gelegentlich Ureterenkatheter eingeführt. —

Bei *inkompletter äusserer Fistel (Fig. 7b)* wird durch die Fistelöffnung am Hals injiziert, nachdem allfällig vorhandenes Sekret abgesaugt worden ist.

Besteht eine *komplette mediane Halsfistel (Fig. 7c)*, so wird das Kontrastmittel durch die äussere, d. h. tiefer liegende Fistelöffnung injiziert. Es steigt dann unter dem Injektionsdruck der Schwere entgegen im Gangsystem auf und füllt so sicher alle Verzweigungen und Sinus. Sobald der Pat. angibt, dass »etwas in den Hals fliesse» (Schweizer), wird die Aufnahme gemacht. — Die Injektion durch das Foramen caecum, die nach Takeda leichter auszuführen sei, hat den grossen Nachteil, dass das Kontrastmittel durch die äussere Fistelöffnung abfliesst. Man riskiert dann, dass gar nicht alle Teile der Gangbildung gefüllt und dargestellt werden.

Besitzt die Zyste *weder eine innere, noch eine äussere Fistelöffnung (Fig. 7d)*, so punktieren wir mit einer scharfen Nadel von aussen her. Man lässt die Nadel nach der Kontrastmittelinjektion unverändert stecken, um nach Anfertigung und Durchsicht der Filme das Kontrastmittel wieder abzusaugen. (Wangensteen.)

Zum Schluss wäre noch darauf hinzuweisen, dass Pemberton und Stalker (33) die *Röntgen- oder Radiumbestrahlung* als Nachbehandlung nach der Exstirpation von thyreogenen Missbildungen empfehlen.

ZUSAMMENFASSUNG

Nach einer Übersicht über die Pathologie und Klinik der Ductus-thyreoglossus-Zysten und -Fisteln folgt eine eingehende Schilderung der Embryologie und Teratologie, um daraus eine Richtlinie für die Beurteilung und Klassierung der Röntgenbefunde abzuleiten. Bisher publizierte Röntgenbilder, sowie die Röntgenbilder eines eigenen Falles belegen einige von den Möglichkeiten, die aus der Teratologie erschlossen wurden. Angaben über die Untersuchungstechnik, sowie ein Hinweis auf die Röntgenbestrahlung thyreogener Missbildungen bilden den Schluss.

SUMMARY

A pathological and clinical review of cysts and fistulas of the thyroglossal ductus is presented, followed by a detailed account both of the embryology and the teratology, in order to obtain an adequate method of rating and grading the roentgenological findings. Roentgenographs previously published, as well as pictures taken on one own case include the elements of some of the possibilities afforded by the teratological criteria. The author then describes the technic of examination, whereupon he finally draws attention to the irradiation treatment designed in thyrogenous congenital deformities.

RÉSUMÉ

Une revue de la pathologie et de la clinique des kystes et fistules du canal thyréoglosse est suivie de la description détaillée des faits embryologiques et tératologiques, pour en tirer des directives en vue de l'appréciation et de la classification des observations radiologiques. Les radiographies publiées jusqu'ici, ainsi que celles d'un cas personnel à l'auteur, corroborent quelques unes des possibilités qui ont été déduites de la tératologie. Le travail se termine par des indications concernant la technique d'examen, ainsi que par le rappel du rôle du traitement radiothérapique des malformations thyréogènes.

LITERATURVERZEICHNIS

1. His: Anatomie menschlicher Embryonen. Zur Geschichte der Organe. — Leipzig, 1885.
2. Morgagni: Adversaria anatomica VI. Animadversio XCIII. 1741.
3. Henke-Lubarsch: Handb. pathol. Anatomie. 1. Auflage.
4. Clute and Cattell: Annals of Surgery, Bd. 92, 1930. S. 57—66.
5. Strauch: Münch. med. Wschr. Bd. 61, II, 1914, S. 422—423.
6. Baumgartner: Surgery, Gynecology and Obstetrics, Bd. 56, 1933, S. 948—955.
7. Gilman: Surgery, Gynecology and Obstetrics, Bd. 32, 1921, S. 141 ff.
8. Sistrunk: Surgery, Gynecology and Obstetrics, Bd. 46, 1928 S. 109—112.
9. v. Herepey-Csakanyi: Zbl. Chir. 1927, S. 2631—2633.
10. Wangensteen: Annals of Surgery, Bd. 93, 1931, S. 790—792.
11. His: Anatomie menschlicher Embryonen. Embryonen des ersten Monats. — Leipzig 1880.
12. Patzelt: Anat. Anz. Bd. 57, 1923.
13. Wenglowski: Arch. klin. Chir. Bd. 98, 1912, S. 151—208.
14. Rabl: Zschr. mikroskop.-anat. Fschg. Bd. 26, 1931, S. 347—370.
15. Neumann: Berl. klin. Wschr. Bd. 54, 1917, S. 25—28.
16. Sistrunk: Annals of Surgery, Bd. 71, 1920, S. 121—122.
17. Delseries: Rev. de laryngologie, Bd. 57, 1936, S. 93—106.
18. Snoke: Amer. J. Roentg. 1930.
19. Smokwina: Zbl. Hals-Nasen-Ohrenhlkd. Bd. 18, 1932, S. 575.
20. Capua: Zbl. Hals-Nasen-Ohrenhlkd. Bd. 26, 1936, S. 632.
21. Jones: Zbl. Hals-Nasen-Ohrenhlkd. Bd. 7, 1925, S. 562.
22. v. Gangelen: Zbl. Hals-Nasen-Ohrenhlkd. Bd. 19, 1933, S. 445.
23. Schweizer: Schweiz. med. Wschr. 1929, S. 250.
24. Kinsella: Brit. J. Surg. Bd. 26, 1936, S. 714—720.
25. Colp and Klingenstein: Annals of Surgery, Bd. 82, 1924.
26. Haeusser: Über die Entartungen des Ductus thyreoglossus. Diss. Stuttgart, 1938.
27. Chemin: Contribution à l'étude des restes chez l'adulte de l'ébauche thyroïdienne médiane. — Diss. Bordeaux, 1895.
28. Shugyo: Zschr. d. Jap. Oto-rhino-lar. Ges. 26. (zitiert nach Takeda).
29. Takeda: Dtsch. med. Wschr. Bd. 48. 1922, S. 1649—1650.
30. Clark: Positioning in radiography. — London, 1945.
31. Boss: Brun's Beitr. klin. Chir. Bd. 126, 1922, S. 658—661.
32. Bailey: Physical signs in clinical Surgery, p. 34. Wm. Woods and Co. 2d ed. 1930 (zitiert nach Wangensteen).
33. Pemberton and Stalker: Annals of Surgery, Bd. 111, 1940, S. 950—957.

Ein vollständiges Literaturverzeichnis bis 1929 findet sich bei Neris, G. R.: Le tractus thyreoglosse. — Gaston Doin & Cie. Paris, 1929.

POINTS REGARDING SYNOVIAL FIBROSARCOMA[1]

by

Gunnar Jönsson

The January number of this journal contained a paper by FOLKE KNUTSSON entitled »Two Synovial Fibrosarcomas». The purpose of this paper was to contribute to the diagnosis of these tumors. However, KNUTSSON also touched upon their clinical properties and in this connection referred to a monograph of mine. As this part of his paper is misleading in some respects, a few complementary remarks to his presentation are necessary.

He writes: »The synovialomas are more malignant and metastasize often to the regional lymph glands, the lungs and the internal organs. The synovial fibrosarcomas, on the other hand, very seldom metastasize to the lungs and other internal organs.» His statement about the synovial fibrosarcomas is not borne out by my monograph. In 3 of the 8 cases taken up in my publication, pulmonary metastases developed. In one of these the patient had previously had a metastasis in the soft parts of the back. Vertebral metastases were found in one instance. There was no case of metastasis to the regional lymph glands, on the other hand, though this was a common site of metastasis in the cases of synovialoma.

The most important differences between synovialoma and synovial fibrosarcoma are the following: 1) Synovialomas contain endothelium-lined cavities, formations which are lacking in synovial fibrosarcomas. 2) Synovialomas metastasize often, not to say regularly, to the regional lymph glands. Synovial fibrosarcomas do not. Both types of tumor, on the other hand, metastasize to the lungs and other distant organs. 3) Synovialomas are often highly radiosensitive, synovial fibrosarcomas insignificantly so. In other respects, there is a great resemblance between the two types of tumor, even as regards prognosis, as I pointed out in my monograph. Synovialomas up to now have run a very unfavorable course and are considered to have a very poor prognosis. The prognosis of synovial fibrosarcomas appears to be somewhat better, *but even these tumors must be regarded as very serious.*

[1] Submitted for publication, April 7, 1948.

KNUTSSON pointed out in his article the diagnostic importance of the fact that synovial fibrosarcomas often contain calcific deposits. Deposits of this kind do not occur in synovialoma or inflammation in the tendon sheaths, bursae or joint capsules. The deposits, which are characteristic in appearance, can be demonstrated roentgenographically and permit a correct diagnosis in most cases. In my aforementioned monograph (Acta Radiologica, suppl. 36) I described 8 cases of synovial fibrosarcoma. In 3 of them the tumor and adjacent tissue were roentgenographed. Two cases showed no roentgenographic changes but the third (case 91, page 128) exhibited a number of irregular calcific deposits at the place of the tumor. The tumor was excised »in healthy tissue» but roentgen examination afterwards revealed calcifications of soft parts of the same type as before the operation and it was therefore evident that remains of the tumor were left. The subsequent history showed this diagnosis to be correct. In spite of radiologic treatment, the tumor began to grow rapidly after about six months and chest examination showed lung metastases.

This case is described in a large monograph which deals with soft tissue tumors mainly from a clinical and radiotherapeutic point of view and has no doubt escaped the attention of the roentgen diagnosticians. It is a good thing, therefore, that KNUTSSON has now pointed out the diagnostic importance of the calcific deposits common in cases of synovial fibrosarcoma and described their characteristic appearance.

SUMMARY

A short review of the most important differences between synovialoma and synovial fibrosarcoma.

ZUSAMMENFASSUNG

Eine kurze Beschreibung der wichtigsten Unterschiede zwischen Synovialomen und synovialen Fibrosarkomen.

RÉSUMÉ

Une courte description des différences principales entre les synovialomes et les fibrosarcomes synoviaux.

AUS DEM RÖNTGENINSTITUT DER UNIVERSITÄT BASEL, SCHWEIZ (LEITER: PROF. DR. M. D. MAX LÜDIN)

ZUR FRAGE DES RÖNTGENOLOGISCHEN NACHWEISES DES SENKUNGSABSZESSES IM LENDENGEBIET[1]

Beitrag zur »Frühdiagnose« der Spondylitis tuberculosa

von

C. Buetti

Dank der Einführung äusserst empfindlichen Filmmaterials, der vermehrten Leistungsfähigkeit der Röntgenröhren, der Anwendung des tomographischen Verfahrens und gestützt auf die grundlegenden Arbeiten von SCHMORL und JUNGHANNS, MÜLLER, SIMONS und LIECHTI u. a. hat die Röntgendiagnostik der Wirbelsäule bedeutende Fortschritte gemacht, hat sich wesentlich verfeinert.

Nichtsdestoweniger kommt es manchmal vor, dass man sich zu einem geringen Befund an der Wirbelsäule nicht äussern kann, besonders wenn man einen incipienten Prozess vermutet, der nicht von verdächtigen indirekten Röntgensymptomen begleitet ist.

Gerade bei solchen relativ geringen Befunden an der Wirbelsäule (Wirbelkörper und Bandscheiben) wird oft die Möglichkeit des Vorhandenseins einer tuberkulösen Veränderung in Erwägung gezogen; der Befund scheint aber im Moment zu gering, um bei der Annahme einer tuberkulösen Veränderung konsequent eine entsprechende Behandlung zu verordnen und durchzuführen.

Man begnügt sich bei solchen Fällen, speziell beim Verdacht auf Tbc., damit, den Patienten unter Kontrolle zu behalten, und bei weiter bestehenden klinischen Erscheinungen eine Röntgenkontrolluntersuchung innert einiger Zeit durchführen zu lassen.

Es wird von verschiedener Seite und speziell von Autoren, die sich mit dem Problem der Wirbelsäulentuberkulose eingehend beschäftigt haben, angeraten, diese Kontrolle nach 3—6 Monaten durchzuführen. An Hand unserer Beobachtungen möchten wir hier feststellen, dass diese Zeitspanne im speziellen bei den Fällen, wo die Möglichkeit einer Spondylitis tuberculosa offen bleibt, zu gross ist. In diesen Fällen ist es ratsam,

[1] Bei der Red. am 14. XI. 1947 eingegangen.

ein Kontrolle bereits nach 4—6 Wochen durchführen zu lassen, um unangenehme Ueberraschungen zu vermeiden, die sich auf den Verlauf, die Dauer und die Prognose schwerwiegend auswirken würden.

Die röntgenologische Untersuchung der Wirbelsäule bei einem klinisch auf Tbc. verdächtigen Patienten erschöpft sich aber nicht in der Analyse der im Bereich der Bandscheibe-Wirbelkörper nachweisbaren Veränderungen. Von verschiedener Seite ist auf die Wichtigkeit des Nachweises eines paravertebralen abnormen Begleitschattens hingewiesen worden.

Bekanntlich ist das Vorhandensein bezw. die Darstellbarkeit eines tuberkulösen Senkungsabszesses nicht im Zusammenhang mit der Grösse resp. Ausdehnung des Prozesses an den Wirbeln (LIECHTI, FREUND). Ja es sind sogar in der Literatur Fälle beschrieben worden, wo das erste und eine zeitlang einzige röntgenologisch nachweisbare Symptom die ein- oder beidseitige abnorme Verbreiterung des paravertebralen Begleitschattens im Thoraxabschnitt oder in der Lendengegend des Psoasschattens war.

Auf diese indirekten Symptome ist, soweit sie darstellbar sind, besonders zu achten, nicht nur bei einem auf Tbc. sehr verdächtigen Fall, sondern, und wir möchten sagen noch mehr, bei den Fällen, wo die anamnestischen Angaben nicht überzeugend erscheinen und speziell, wenn der angebliche Ausgangspunkt der klinischen Erscheinungen ein Trauma gewesen oder ein solches interkurrent vorgekommen ist. Die röntgenologische Darstellung einer Veränderung des Psoasschattens — um uns auf die Lendengegend zu beschränken — ist aber manchmal nicht möglich. Die Häufigkeit der Feststellbarkeit eines verbreiteten Muskelschattens wird von den verschiedenen Autoren verschieden geschätzt. So können nach LIECHTI »röntgenologisch mehr als 80 % der gesamten Abszesse diagnostiziert werden; die fehlenden 20 % gehören meistens der Gruppe der Psoasabszesse an».

Das ist wohl begreiflich; denn die Hindernisse, die manchmal einer guten Darstellbarkeit des Psoasschattens im Wege stehen, sind nicht gering; wir erwähnen u. a. einen deutlichen Meteorismus im Dick- und speziell im Dünndarmgebiet, einen gefüllten Darm, eine Adipositas des Patienten. Ferner kann eine schiefe Haltung des Patienten bei der Aufnahme zu einer Asymmetrie bezw. zu einer anscheinenden Deformation der Psoasweichteilschatten führen. Andererseits kann die Begrenzung des M. quadratus lumborum, ungefähr 2—3 Fingerbreiten neben der Psoaskontur, ab und zu sichtbar werden und damit eine Verbreiterung des Psoasschattens vortäuschen. Es werden bei solchen Fällen, soweit das Hindernis zu beheben ist, Kontrollaufnahmen verlangt, die aber häufig zu keinem besseren Resultat führen. Verfügen wir über einen Tomographen, so werden wir doch zuerst von dieser Möglichkeit Gebrauch machen, um in einem auf der gewöhnlichen Aufnahme intakt erschei-

nenden, klinisch jedoch suspekten Wirbelkörper einen etwaigen Destruktionsprozess, bzw. eine Höhle zu entdecken.

Die Leistungsfähigkeit des tomographischen Verfahrens hat aber auch ihre Grenzen und wenn angenommen wird, dass bei den gewöhnlichen Aufnahmen ein Cavum mit Sitz in einem Wirbelkörper erst bei einer Grösse von 1.5 cm Durchmesser darstellbar wird, so gilt dies für das tomographische Verfahren für ein nicht unter 0.5 cm messendes. Trotz der Verbesserung der Knochendiagnostik durch das Schichtverfahren hat sich diese Methode noch nicht recht eingebürgert, nicht zuletzt, da die Apparatur z. Zt. nur in relativ wenigen Instituten vorhanden ist.

Dass man deshalb neben dem Psoasschattensymptom nach weiteren indirekten Zeichen sucht, für welche röntgenologisch die Möglichkeit einer besseren Darstellung besteht, ist begreiflich. Dies umsomehr, wenn es sich um einen Befund im Bereich der Lendenwirbelsäule handelt, wo differentialdiagnostisch bei relativ spärlichen klinischen Symptomen und unklarer Anamnese neben dem Verdacht auf eine Tbc. andere Möglichkeiten in Erwägung gezogen werden müssen. Wir denken insbesondere an diejenigen Fälle, bei welchem sich im Anschluss an ein mehr oder weniger schweres Trauma das klinische Bild eines chronisch entzündlichen Prozesses entwickelt hat oder bei bereits bestehenden klinischen Erscheinungen ein auf einen Entzündungsprozess verdächtiges Moment hinzugekommen ist. Bevor man bei solchen Fällen den Verdacht einer Tbc. ausschliesst oder sich gar zu einem operativen Eingriff entschliesst, sollen alle möglichen röntgenologischen Untersuchungen herangezogen werden. Wie gross nämlich die Gefahren und wie schwerwiegend die Folgen eines Eingriffes auf die Wirbelsäule beim Vorhandensein einer tuberkulösen Veränderung sein können, ist aus der Literatur an Hand von Fällen mit letalem Ausgang genügend bekannt. Ein grosser Teil dieser tragischen Fälle scheint sich zur Zeit der »Discushernienwelle», die übrigens jetzt im Abflauen ist, ereignet zu haben.

Als typisches eindruckvolles Beispiel erinnern wir uns an einen von LANG mitgeteilten Fall:

Auf Grund einer plötzlich eingetretenen Ischias wurde bei einem Patienten, zwei Jahre nach einem Rückentrauma, eine Röntgenuntersuchung veranlasst. Es wurde an Hand der Bilder eine alte Fraktur von L 3 mit Spondylose angenommen. Mit Verdacht auf Nucleushernie wurde eine Myelographie durchgeführt; das Ergebnis war ein Stop des Kontrastmittels auf der Höhe von L 3. Daraufhin Laminektomie L 2—L 4. Entsprechend der Höhe der Bandscheibe von L 3 wurde ein annähernd erbsengrosser, prall elastischer Tumor festgestellt. In der Annahme, dass eine mediane Discushernie vorliege, schreitet man zur Spaltung der ventralen Dura und des hinteren Längsbandes. Aus der Vorwölbung entleerte sich ein dickflüssiger, gelblicher Eiter. Im Bereich der Bandscheibe liess sich eine grosse Höhle nachweisen, die ausgekratzt wurde. Bald darauf Exitus.

Sektion: Spondylitis Tbc. des 3. und 4. Lendenwirbelkörpers mit Senkungsabszess; Haematogene Miliartbc.

Es wird im Bericht betont, dass die Differentialdiagnose: Trauma (Fraktur) oder Tbc. röntgenologisch nicht möglich war: möglicherweise hätte eine Fraktur vor der Tbc. bestanden.

Hätte man den vorliegenden Senkungsabszess (Psoasabszess) direkt (Veränderung des Psoasschattens) oder indirekt nachweisen können, so wäre das Endergebnis in diesem Falle sehr wahrscheinlich anders gewesen.

Nicht nur dieses Beispiel, sondern auch statistische Arbeiten aus neurochirurgischen Kliniken mahnen zur Vorsicht vor einem verfrühten Entscheid, speziell vor einem übereilten operativen Eingreifen bei nicht restlos abgeklärten Fällen im Lendengebiet.

So berichtet KRAYENBÜHL in einer statistischen Arbeit über 220 Fälle, die wegen chronischer, therapieresistenter Ischias und Lumbago mit Verdacht auf Nukleushernie laminektomiert wurden. In 134 Fällen konnte eine Diskushernie entfernt werden, 86 Mal aber verlief die Operation negativ.

An einem in unsere Beobachtung gekommenen Fall ist uns aufgefallen, dass es beim Fehlen deutlicher Psoasschattenkonturen und beim Vorhandensein eines geringen Wirbelsäulenbefundes eine Möglichkeit gibt, manchmal das Vorliegen eines Senkungsabszesses auf indirekte Weise zu erschliessen.

Bei unserem Fall handelt es sich um eine 22-jährige Patientin (K. Bl., Haustochter, aus dem Elsass), deren Familienanamnese speziell bezüglich Tbc.-Erkrankungen völlig negativ ist. In der persönlichen früheren Anamnese ist lediglich eine Appendektomie mit 13 Jahren zu verzeichnen. Keine Lungen- oder Brustfellentzündungen. — Der Beginn der jetzigen Beschwerden geht auf den Frühling vor 2 Jahren (1945) zurück. Es begann mit einem dumpfen diffusen Schmerz in der Kreuzgegend, der sich besonders beim Aufstehen bemerkbar machte. Ein ganzes Jahr lang blieben die Schmerzen ungefähr gleich stark; während dieser Zeitspanne blieb der Allgemeinzustand ordentlich; kein Fieber, kein Nachtschweis usw. Patientin konnte gut Spaziergänge machen, Velo fahren. Nach einem Jahr wurden die Beschwerden der Patientin deutlicher; Zunahme der Kreuzschmerzen, besonders beim Bücken; dieselben waren vorwiegend in die linke Lendengegend zu lokalisieren. Es trat ferner bei allgemeiner Müdigkeit eine Gewichtsabnahme auf. 2 Monate später, Velo-unfall; Sturz vom Velo auf das Gesäss. Patientin fuhr trotzdem noch ca 20 km nach Hause. Danach Auftreten von Fieber während 14 Tage zwischen 37.5 und 38 Grad. Gleichzeitig starke Zunahme der Lendenschmerzen, sodass die Patientin sich nicht mehr gerade halten konnte. Da der Zustand sich nicht besserte, erfolgte Einweisung der Patientin in ein Bezirksspital. Während des 9-wöchigen Spitalaufenthaltes bestand Subfebrilität, die BSR. war nach Angaben der Patientin konstant »schlecht». Es wurde

anscheinend auf »alles» geröntgt ohne angeblich einen Befund zu erheben. Wurde mit Salicyl i. v., Diathermie und Massage behandelt. Entlassung nach Hause in einem eher verschlimmerten Zustand; die Schmerzen hatten weiter zugenommen, die Patientin war ständig bettlägerig.

Im Herbst des 2. Jahres — Sept. 1946 — nach Beginn der Beschwerden, da der Zustand der Patientin Tendenz zu weiterer Verschlechterung zeigte, nochmalige Einweisung auf die Medizinische Abteilung einer Universitätsklinik, im Ausland.

Im Verlauf des 3-monatigen Aufenthaltes wurde die Patientin durchuntersucht. Unter anderem wurden bei der Patientin neuerdings Aufnahmen der ganzen Wirbelsäule angefertigt; ferner Tomogramme der LWS. Da die Patientin die Schmerzen vor allem in die linke Nierengegend lokalisierte, wurde auch eine retrograde Pyelographie ausgeführt.

Auf das Ergebnis, bezw. auf den Befund dieser Aufnahmen werden wir zurückkommen. Als Therapie bekam die Patientin: Dampfbäder, Massage, Salicyl. Ferner wurde sie tonsillektomiert und die Zähne wurden saniert. Auf Grund der damals erhobenen Befunde bei der Röntgen- und speziell tomographischen Untersuchung wurde die Frage eines operativen Eingriffes (Laminektomie) aufgeworfen. Patientin verweigerte aber jedwede Operation. Bei der Entlassung — 3 Monate nach Aufnahme — habe die Patientin ziehende Schmerzen an der linken Hüfte mit Ausstrahlungen bis ins linke Knie verspürt; sie bemerkte, dass bei leichter Flexion des Beines in der Hüfte eine Abnahme der Schmerzen eintrat. Zu Hause, über den Winter, langsame, aber progressive Verschlechterung des Allgemeinzustandes und der lokalen Beschwerden. Von ihrem Hausarzt wird dann die Patientin auf die Medizinische Klinik Basel zur Abklärung eingewiesen.[1]

Status vom 15. 4. 47 (rund 2 Jahre nach Beginn der subjektiven Beschwerden): Patientin in reduziertem Ernährungszustand; geringer Panniculus. Aktive Bettlage; die Patientin kann sich jedoch nur mit grosser Mühe und starken Schmerzen in sitzender Lage halten. Kopf, Hals o. B. Thorax: Lungen, Herz o. B.

Abdomen: Im Bereich der linken Inguinalgegend vermehrte Bauchdeckenspannung; keine sicher abgrenzbare Resistenz zu spüren.

Wirbelsäule: Mässige Druckempfindlichkeit von L III—L IV; im unteren Lumbalbereich geringe linkskonvexe Skoliose. Keine Zeichen von Gibbus, Beweglichkeit der LWS. sehr eingeschränkt, besonders die Beugung. In der linken Lendengegend, paravertebral über der Crista iliaca, ist eine flache, ungefähr 5 cm im Durchmesser messende, etwas druckdolente Vorwölbung sichtbar. Angedeutete Fluktuation auf der Höhe dieser Vorwölbung.

[1] Für die Ueberlassung der Krankengeschichte bin ich Herrn Professor H. Staub, (Med. Universitätsklinik Basel) zu besonderem Dank verpflichtet.

Extremitäten: Reflexe beidseits positiv, lebhaft; links Lasègue positiv.

Gynäkologische Untersuchung: Uterus sehr klein, hypoplastisch, spitzwinklig anteflektiert. Linke Adnexe leicht druckempfindlich, ohne palpatorischen Befund. Gegend des linken Ileosacralgelenkes und darüber druckempfindlich.

Laborbefunde: BSR: 78/144; 85/121. WaR., Citochol, Kahn: negativ. Harnstoff: 22 mg%; Rest-N: 27 mg%. Takata: neg. Gesamt-Eiweiss: 7.8 gr.%; A/G: 0.865. Fibrinogen: 444 mg%. Urinbefund: o. B. Blutbild: Hg. 69 %; E.: 3,450,000, F. I.: 1.0; Leuko 8,400, davon 6 % Stabkernige Serumeisen 43 y %.

Verlauf: Die Vorwölbung in der Lendengegend wurde 2 Mal punktiert; die Punktion ergab total ca 100 ccm braungelben sterilen Eiter. Mikroskopisch liessen sich im Abszess-Eiter keine Tuberkelbazillen nachweisen. Der mit Abszess-Eiter eingeleitete Tierversuch fiel positiv aus. Konstante Subfebrilität während des Klinikaufenthaltes. Körpergewicht von 42 auf 39.5 kg.

Therapie: Gipsbett. Fettreiche Diät. Ferro-Redoxon-Tabletten. Calcium-Redoxon. Salzsäure-Pepsin.

Uns interessieren die Röntgen-Aufnahmen, die von der Patientin beim ersten Klinikaufenthalt im Ausland angefertigt wurden. Aufnahmen vom 9. 9. 46 (LWS. a.-p. und seitlich, Abb. 1 und 2): Der abgegebene Befund sprach von einem »leger pincement» der Intervertebralscheibe zwischen L III und L IV bei erhaltener Knochenstruktur. Diese Feststellung gab Veranlassung zu einer tomographischen Untersuchung.

Auf einem Schnittbild 1 cm rechts von der Mittellinie (Abb. 3) wurde eine ovale Eindellung in der Mitte der Grundplatte von L III und der Deckplatte von L IV mit scharfen regelmässigen Konturen festgestellt (siehe Pfeile).

Nach diesen Untersuchungen wurde folgender Befund abgegeben: Traumatische Verschmälerung der Intervertebralscheibe L III—L IV mit Hernie des Nucleus pulposus gegen die entsprechende Grund- und Deckplatte. Die Knochenstruktur der einzelnen Wirbelkörper lässt keinen verdächtigen Befund erkennen.

Eine Woche später wurde eine retrograde Pyelographie veranlasst: Ueber diese Untersuchung wurde ein negativer Röntgenbefund abgegeben (Abb. 4).

Was die Aufnahmen 1 und 2 betrifft, so konnten auch wir bis auf eine Verschmälerung der Intervertebralscheibe L III—L IV keinen weiteren sicheren pathologischen Befund erheben. Die auf dem Tomogramm festgestellte, symmetrische, oval geformte, regelmässig und scharf konturierte Eindellung an der Grundplatte des III. und an der Deckplatte des IV. LWK. schien uns unverdächtig, speziell für eine traumatische Entstehung. Bei der Tomographie der Lendenwirbelkörper kommt auf einem der

Abb. 1.

Abb. 2.

Abb. 3.

Mitte des Wirbelkörpers entsprechenden Schnittbild ein solcher Befund auch häufig normalerweise vor. Eine Deformation des Psoasschattens konnte nicht festgestellt werden, wohl auch infolge der harten Aufnahmetechnik.

Am interessantesten sind der Befund und die Schlussfolgerungen, die sich bei der als negativ angegebenen retrograden Pyelographie (1 Woche nach den Wirbelaufnahmen durchgeführt) ableiten lassen. Das Pyelogramm (Abb. 4) lässt rechts eine regelmässige Füllung des Nierenbeckens und der Nierenkelche erkennen. Das Aussehen ist unverdächtig, die Konturen scharf, regelmässig. Die Niere steht als ganzes etwas tiefer als normal; der Abstand von den Mittellinie der Wirbelsäule ist jedoch nicht vergrössert. Die sagittale Längsachse der Niere verläuft wie normal von oben nach unten und von innen nach aussen. Die mediale Kontur des Nierenschattens verläuft parallel dem Psoasschatten. Regelmässiger Verlauf, bezw. normale Bogenbildung des Ureters.

Abb. 4.

Abb. 5.

Links lässt sich folgendes feststellen: Die Niere erscheint »aufgerichtet«, d. h. ihre Längsachse verläuft beinahe parallel der Wirbelsäulenmittellinie. Die Füllung der Nierenkelche ist normal; im Vergleich mit den rechten erscheinen sie aber wie verkürzt, plumper, kontrastreicher. Das Nierenbecken ist in seinem medialen Teil mangelhaft gefüllt, sieht zum Teil wie ausgelöscht aus. Der Abstand des Nierenbeckens von der Wirbelsäulenmittellinie ist deutlich grösser als normal; das gleiche lässt sich vom Ureter sagen, der einen fast geradlinigen Verlauf von aussen nach innen bis auf Höhe des Sacrum aufweist. Die Aufnahme lässt ferner oberhalb des linken Darmbeinkammes einen verbreiterten Psoasschatten vermuten.

Schon nach Besichtigung der alten auswärtigen Wirbelsäulenaufnah-

Abb. 6.

men zusammen mit dem Pyelogramm (ganz abgesehen vom Ergebnis der neuen Kontrollaufnahmen in unserem Institut) konnten wir rein röntgenologisch vor Kenntnis des klinischen Bildes und des Punktionsergebnisses die sehr wahrscheinliche Diagnose: Senkungsabszess links bei tuberkulöser Veränderung der Intervertebralscheibe, resp. LWK. III—LWK. IV aussprechen.

Die Kontrollaufnahmen der Lendenwirbelsäule in unserem Institut, genau 5 Monate nach dem Pyelogramm angefertigt, bestätigten unseren Befund (Abb. 5 und 6). Sie lassen nämlich eine weitere Verschmälerung der Intervertebralscheibe und eine Sklerosierung der angrenzenden Knochenpartien des III. und IV. LWK. erkennen. Ferner kommt, auf dem Originalfilm besonders deutlich, unterhalb der Deckplatte des IV. LWK. eine annähernd ovale, unscharfe Aufhellung zum Vorschein. Der untere Teil des linken Psoasschattens weist eine deutliche Verbreiterung auf. Die Klinik- und die Laborbefunde bestätigten dann den Röntgenbefund.

Das Zustandekommen des Röntgenbefundes auf dem Pyelogramm lässt sich leicht verstehen wenn man sich der topographischen Verhältnisse zwischen Niere, Ureter und Psoasmuskulatur erinnert.

Normalerweise ist die Längsachse der Niere entsprechend dem Verlauf des M. Psoas, dem sie zum Teil anliegt, schräg gestellt, nämlich von oben innen nach unten aussen. Weiter liegt die Niere auch schräg zur Frontalebene, da wegen Dickezunahme des M. Psoas von oben nach unten der caudale Pol von der hinteren Leibeswand weiter entfernt liegt als der craniale.

Auch der Querdurchmesser der Niere liegt schräg zur frontalen Ebene, da infolge der Vorwölbung des M. Psoas und der Höhlung der Leibeswand der mediale Rand der Niere weiter ventral liegt als der laterale. Dadurch ist leicht zu verstehen, dass entsprechend der Dickezunahme der Psoasloge durch den Senkungsabszess der Verlauf der Nierenlängsachse sich verändert im Sinne einer »Aufrichtung» und der Querdurchmesser der Niere seine schräge Lage zur Frontalebene verstärkt. Vorwiegend auf diese Achsendrehungen ist das veränderte Röntgenbild der Nierenkelche links (kurz, plump, sehr kontrastreich infolge partieller Schatten-Summation) zurückzuführen.

Was den medialen Rand der Niere betrifft, so ist zu bemerken, dass

sich derselbe nicht in den Winkel zwischen Psoas und Quadratus einschiebt, sondern vielmehr der abgerundeten Fläche des M. Psoas aufliegt; dies trifft vor allem für die dorso-mediale Wand des Nierenbeckens zu, die in Beziehung mit der Psoasfläche kommt.

Vorausgesetzt, dass die Form und Lage der Niere normal ist, beträgt der Abstand des medialen Randes des Nierenbeckens von der Wirbelsäulenmittellinie etwa 5—6 cm.

Auch unter der Berücksichtigung, dass in unserem Falle eine beidseitige mässige Ptosis der Niere vorliegt (was beim Habitus asthenicus der Patientin, starker Abmagerung, deutlicher Erschlaffung der Bauchdeckenmuskulatur wohl begreiflich ist), erscheint der Abstand des linken Nierenbeckens von der Wirbelsäulenmittellinie abnorm gross.

Der Ureter liegt normalerweise in seiner Pars abdominalis auf dem M. Psoas bezw. seiner Fascie und ist im proximalsten Teil in die Nierenkapsel eingebettet. In seinem Verlauf sind 2 charakteristische Windungen zu unterscheiden, von denen die cranialste, gegen die Wirbelsäule konvex, auch bei normalen Fällen, nicht immer nachzuweisen ist; fehlt sie, so ist dieser Befund meist beidseits vorhanden und der Ureter verläuft bis zu seiner 2. Windung parallel zur Wirbelsäule. Die 2. Krümmung, im kleinen Becken gelegen, mit lateralwärts gerichteter Konvexität, ist mehr minder ausgeprägt, fast ausnahmslos vorhanden.

In unserem Fall sind nun rechts trotz leichter Ptose der Niere Verlaufsrichtung und Windungen des Ureters normal; links hingegen fehlt die oberste Windung und der Harnleiter zieht fast gerade von lateral oben nach medial unten zur 2. Windung.

Nach diesen Feststellungen lässt sich, wenn man einen Schluss aus dem vorliegenden Fall ableiten darf, folgendes sagen:

Es hat sich nochmals bestätigt, dass von Wirbelsäulenerkrankungen herrührende, sogar ausgedehnte Senkungsabszesse vorhanden sein können, ohne dass durch die gewöhnliche Aufnahmetechnik eine sichere Knochenveränderung oder die Senkungsabszesse selbst — speziell im Lendengebiet — festgestellt werden könnten.

Weiters kann in seltenen Fällen eine perirenale Tbc. durch Einbruch des Abszesses in die Psoasscheide manifest werden.

Verbreiterung des Psoasschattens kommt nicht zuletzt nach Wirbelsäulen- und Querfortsatzbrüchen vor.

Schliesslich bei Tumoren (primären oder am häufigsten sekundären), die innerhalb oder ausserhalb der Psoasloge liegen jedoch durch die Ueberlagerung der paravertebral gelegenen tumorösen Massen eine Verbreiterung des Muskelschattens vortäuschen. (Lymphogranulomatose, Sarkome, Seminome, Riesenzellgeschwülste, Metastasen.)

Wenn auch differentialdiagnostisch all diese Möglichkeiten ins Auge gefasst werden müssen, so wird man an Hand der Anamnese, des

klinischen Verlaufes, der Labor- und übrigen Untersuchungsergebnisse genügend Hinweise haben, um meistens die richtige Diagnose stellen zu können.

Es scheint uns daher, dass bei einem geringen oder sogar nur vermuteten Prozess der LWS. die retrograde Pyelographie als zusätzliche röntgenologische Methode — also nach den üblichen Röntgenuntersuchungen — herangezogen werden darf. Zu diesem Zweck hat sie bis jetzt unseres Wissens keinen Gebrauch gefunden. Der Pyelogrammbefund ist dann verwertbar, wenn sich bei klinischem oder röntgenologischem Verdacht auf einen Tbc.-Prozess der LWS. eine oder mehrere der folgenden Abweichungen vom normalen Pyelogrammbild finden:

a) Verlagerung des Nierenschattens nach lateral, gut messbar an der Zunahme des Abstandes der medialen Nierengrenze von der W. S.-Mittellinie;

b) Drehung der Niere um die Längs- und Querachse, wodurch einerseits eine »Aufrichtung» des Nierenschattens, andererseits eine Verkürzung und Verplumpung der Kelche auftritt, die infolgedessen kontrastreicher erscheinen können;

c) Mangelhafte Füllung und damit mangelhafte Darstellung des Nierenbeckens, vorwiegend im medialsten Anteil;

d) Vermehrter Abstand des Ureteres von der W. S.-Mittellinie; abnorme Verlaufsrichtung, in unserem Fall zudem mit Aufhebung der ersten Krümmung.

Die Details der Abweichungen vom normalen Pyelogrammbild sind natürlich von der Höhe abhängig, auf welcher der Senkungsabszess seine grösste Ausdehnung erreicht hat.

ZUSAMMENFASSUNG

Zur »Frühdiagnose» einer Spondylitis tuberculosa im Lendengebiet kann die retrograde Pyelographie angewendet werden, da sie manchmal das Vorhandensein eines sonst nicht nachweisbaren Senkungsabszesses auf indirekte Weise (Veränderung am Nieren- und Ureterbild) erkennen lässt.

SUMMARY

Retrograde pyelography may justifiably be used for the early diagnosis of a tuberculous spondylitis in the lumbar region, as this procedure sometimes permits recognition of a cold abscess (visualizing changes within the kidney and ureter), which would not be demonstrable by other criteria.

RÉSUMÉ

Pour le »diagnostic précoce» d'une spondylite tuberculeuse de la région lombaire la pyélographie rétrograde est utilisable, car elle met parfois en évidence de façon indirecte l'existence d'un abcès froid »par congestion» (modification des images du rein et de l'uretère) non démontrable autrement.

LITERATURVERZEICHNIS

Brücher, J. E. W.: Die Differentialdiagnose der Wirbelsäulentuberkulose. Thieme Verlag, Leipzig 1941.

De Quervain, F.: Spezielle chirurgische Diagnostik. F. C. W. Vogel Verlag, Leipzig.

Deutsche, P.: Die Bedeutung der Pyelographie für die Diagnose des paranephritischen Abszesses. Zbl. Chir. 1940, 2214—2219.

Freund, E.: Zur Klinik und Radiographie der Spondylitis tuberculosa. Arch. klin. Chir. 159, 434 (1930).

Horn: Beitrag zur Diagnose der Spondylitis luetica, Röntgenprax. 54, 31 (1932).

Joseph, E.: Die Harnorgane im Röntgenbild. Thieme Verlag, Leipzig.

Krayenbühl, H., und Weber, G.: Ergebnisse der Spätresultate der operativen Behandlung lumbaler Diskushernien. Aerztliche Monatshefte für berufliche Fortbildung I, 20 (1945).

Lang, F.: Diskussionsbemerkungen zur Frage der Diskushernie, Wirbelverschiebung und Myelographie. Zeitschr. für Unf. med. und Berufkrankh. 251, 4 (1941).

Liechti, A.: Die Röntgendiagnostik der Wirbelsäule und ihre Grundlagen. Springer Verlag, Wien.

Müller, W.: Pathologische Physiologie der Wirbelsäule. J. A. Barth Verlag, Leipzig.

Pernkopf, E.: Topographische Anatomie. Urban und Schwarzenberg. Berlin und Wien 1941.

Simons, B.: Röntgendiagnostik der Wirbelsäule. G. Fischer Verlag, Jena.

Schmorl, G., und Junghanns, H.: Die gesunde und kranke Wirbelsäule im Röntgenbild. Thieme Verlag, Leipzig.

ERRATA.

In the paper »On Roentgenological Diagnosis of Jejunitis Acuta Phlegmonosa» by O. W. Huseby, in vol. XXIX, fasc. 1, the sentence on p. 80, 6 from below should run: This finding is in contrast to the regular slender fold in the small intestine with its thin intestinal wall and the distended lumen *by intestinal obstruction*.

FRO THE DEPARTMENT OF DIAGNOSTIC ROENTGENOLOGY OF THE CAROLINE HOSPITAL
(AROLINSKA SJUKHUSET), STOCKHOLM, SWEDEN (HEAD: PROFESSOR Å. ÅKERLUND)

ROENTGENOLOGIC CHANGES IN THE URINARY BLADDER AND THE DISTAL PORTION OF THE URETERS IN SPERMATOCYSTITIS[1]

by

Gunnar Edsman

Among the diseases in the distal portion of the urogenital system, spermatocystitis occupies no prominent position and it is clinically fairly seldom diagnosed. Spermatocystitis is rather difficult to diagnose and is sometimes overlooked. Apart from the fact that they are often concealed by coincident and more dominant disease symptoms from adjacent organs, mainly the prostate, the symptoms are vague and may be interpreted in many ways. A fact which also tends to complicate the diagnosis of spermatocystitis is the position of the seminal vesicles which renders palpation difficult.

Radiography has also served as an aid in the diagnosing of diseases of the seminal vesicles. Filling of the seminal vesicles with a positive contrast substance has yielded radiographs which show seminal vesicles and spermatic ducts. The contrast medium has been injected for the most part by two different procedures: Either via the deferent ducts after previous vasopuncture or vasotomy (BELFIELD, ROLNICK, WILHELM, MARTINI, and others), or via the ejaculatory ducts after previous probing of the openings on the colliculus seminalis by means of special urethroscopes (MC CARTHY, HERBST, MERRICKS and others). These methods have been developed during the endeavour to provide an outward drainage for inflammatory processes in the seminal vesicles by surgical means, or merely to douche them with antiseptic solutions. In connection with these interventions, contrasts have been injected for radiographical purposes. However, as a matter of routine, in roentgenologic examinations of patients suspected of having spermatocystitis, one will face many difficulties in the application of any of these methods. The radiographs obtained are not easy to interpret. It may also be difficult, or impossible,

[1] Submitted for publication, Nov. 16, 1947.

to find the openings of the ejaculatory ducts. FRANCOIS, for instance, reports that he has succeeded in filling the seminal vesicles with contrasts in only 2 out of 14 cases submitted to urethroscopic examination. WILHELM also stresses the difficulty of finding the openings in all cases. On the other hand, VON SAAR, for instance, points out the risk of general sepsis as a result of excessive pressure in the infected seminal vesicles when they are filled with contrasts via the deferent ducts, if, at the same time, the ejaculatory ducts are obliterated.

At the urethrocystographic examinations performed on various clinical grounds at the Caroline Hospital, the cystograms have, in some cases, shown deep and irregular indentations of the mucous membrane of the fundus of the bladder, the cause of which has been suspected to be an inflammatory process in the surrounding area, most likely a spermatocystitis. Subsequent clinical examinations have confirmed this suspicion. As this inflammatory change in the fundus of the bladder depicted in the urethrocystogram has not been mentioned in the literature as a sign of spermatocystitis, I intend to describe it in connection with a few cases.

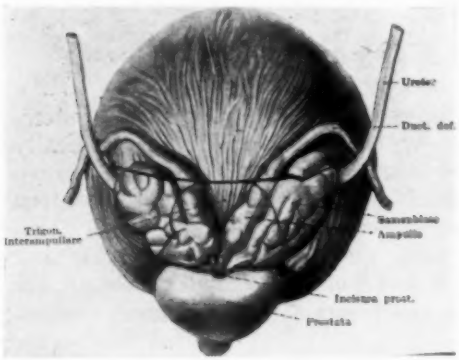


Fig. 1. Posterior view of seminal vesicles, ureters and urinary bladder. (From Handbuch der Urologie. Band 5.)

For the sake of elucidation, a brief account will first be given of the anatomy of the seminal vesicles and the anatomo-pathological changes associated with spermatocystitis.

The seminal vesicles (fig. 1) are located above the prostate, close to the posterior and inferior portion of the wall of the urinary bladder to which they are attached by a loose layer of connective tissue. If superimposed on the mucous membrane of the bladder, they project on the lateral portion of the trigonum vesicae and extend laterally and above the triangle for varying distances. Their extension above the ureteric openings corresponds to the length, or twice the length, of the lateral edge of the trigonum vesicae. The seminal vesicles are not so intimately related to the rectum as to the posterior wall of the bladder. They are separated by a fascia (fascia recto-vesicalis), and here also the peritoneal cavity descends to a depth varying in different individuals.

The seminal vesicles are also intimately related to the ureters; in most

cases the distal portions of the ureters, for a distance of about 1 cm, pass between the wall of the bladder and the fundus of the seminal vesicles. The length of this course varies, from cases where the ureters have no connection whatsoever with the seminal vesicles, to cases where an intimate contact exists for a considerable distance. The close anatomic connection between the ureters and the seminal vesicles is an important factor in the development of the ureter stricture which will be described below.

Fig. 2. Case 1. Patient with clinical symptoms of spermatocystitis. The urethrocystogram shows an irregularity in the contour of the posterior and inferior portion of the bladder.

If an inflammatory process, spermatocystitis, develops in the seminal vesicles, generally caused by a canalicular transmission via the ejaculatory ducts, *e.g.* in posterior urethritis, gonorrhea, or urinary passage infection of some other origin, the area surrounding the seminal vesicles becomes the seat of perispermatocystitis which, via the bladder wall, causes an edema of the corresponding mucous membrane of the bladder. Thus, a localized basal cystitis develops in the mucous membrane of the bladder. Its extent, on the whole, corresponds to the area taken up by the projection of the seminal vesicles on the mucous membrane of the bladder, as described above. This local basal cystitis has been described by several investigators as an important diagnostic sign of spermatocystitis (FULLER, CUNNINGHAM, v. SAAR, FRANÇOIS, and others). VON SAAR, in particular, has stressed this fact and has described 6 cases of spermatocystitis, where he observed a localized basal cystitis on cystoscopic examination. After treatment — in 2 cases a surgical incision — the basal cystitis subsided. The cystitis may manifest itself in any form, from slight vascular congestion to bullous edema with fibrin coatings and, in severe cases, patches of necrosis and even perforation. *Thus, this limited basal cystitis forms the anatomo-pathological basis for the roentgenologic changes in the fundus vesicae, which may be seen in the urethrocystograms in cases of spermatocystitis.* Such cystographic changes were present in the following 5 cases.

Fig. 3. Fig. 4.

Fig. 3. Case 2. Patient with clinical symptoms of spermatocystitis. The urethrocystogram shows a very deep irregularity of the posterior and inferior portion of the bladder.

Fig. 4. Case 2. The same patient as on fig. 3. The radiograph of the colon shows an inflammatory irregularity in outline over a limited area of the rectum.

Case 1. Male, 26 years old. (Surgical Dept., Record No. XX E: 2.) Previously treated in hospital for bilateral hydronephrosis and nephrolithiasis, when left-sided nephrectomy was performed. Repeated attacks of pyelocystitis have been recorded. On Nov. 19th 1942 admitted to the Caroline Hospital with accentuated bladder-trouble and pains in the perineum. *Palpation per rectum* showed a moderately enlarged prostate, particularly tender upwards to the right, where a pronounced tenderness over the right seminal vesicle was also observed. In a *urethrocystogram* made on Nov. 21st, 1942 (fig. 2), a number of prostatic ducts were visualized. The mucous membrane of the bladder showed deep irregularities in the posterior and inferior portion of the wall, indicating a state of irritation in this area. On *cystoscopic examination* on Nov. 23rd, 1942 (Professor HELLSTRÖM), the mucous membrane of the bladder appeared normal, except in the trigone and behind the interureteric ligament, where it showed diffuse redness and, in some places, loose coatings. A *radiograph* of the colon on Dec. 11th, 1942, showed nothing remarkable.

Case 2. Male, 43 years old. (Record No. K 2546-45.) Was taken ill in the summer of 1945 with severe symptoms in the form of a frequent urge to pass water. He was admitted to a small hospital and from there to the Caroline Hospital with diagnosis of cancer of the prostate. On his arrival on Sept. 17th, 1945, the subjective symptoms had subsided considerably. *Palpation per rectum* (Professor HELLSTRÖM) showed a moderately enlarged prostate, distinctly hardened and with, on the whole, well-defined limits. Frontally, on the right side, a very hard nodule, larger than a bean, could be felt. Above, to the right, a hard and knotty body was palpated in a position corresponding to that of the seminal vesicle. A *urethrocystogram* on Sept. 19th, 1945 (fig. 3), showed a very high and

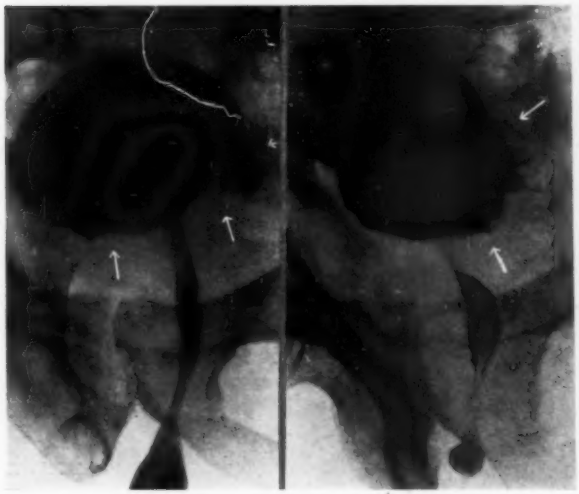


Fig. 5. Fig. 6.

Fig. 5. Case 3. Patient with clinical symptoms of acute spermatocystitis. The urethrocystogram shows inflammatory irregularity of the entire fundus of the bladder.
Fig. 6. Case 4. The urethrocystogram shows an irregular contour of the posterior and inferior portion of the urinary bladder.

irregular elevation of the mucous membrane in the posterior and inferior part of the bladder wall. The bladder was raised and deformed with signs of irritation. The supracollicular portion of the urethra itself was slightly elongated, but otherwise there was nothing noteworthy. At this stage, the nature of the pathologic changes in the fundus of the bladder could not be determined roentgenologically; an inflammatory process in the neighbourhood of the bladder was, however, strongly suspected. *Cystoscopic examination* on Sept. 24th, 1945 (Professor HELLSTRÖM), showed increased trabeculation in the bladder with numerous false diverticula. Owing to hemorrhage from the neck of the bladder the vision was not clear, but it was apparently not a case of cancer of the bladder. The neck of the bladder bulged inwards with an irregular ridge. *Radiography of the colon* on Sept. 28th, 1945 (fig. 4) showed a typical inflammatory alteration of outline of the mucous membrane, over a limited area of the rectum and at the same level as the changes in the urinary bladder previously observed in the urethrogram. The distance between the posterior wall of the rectum and the sacrum was increased, which indicated that the inflammatory process had reached as far as that. *Inspection of the rectum* revealed, in the same place, edematous swelling and redness of the rectal mucosa. On control roentgen examination of the rectum 14 days later, the inflammatory alterations had completely subsided. The patient was also re-examined 4 months later, on Jan. 23rd, 1946, when nothing noteworthy was observed in the urethrocystogram or in the radiograph of the colon. At that time the patient was also free of all symptoms.

Case 3. Male, 74 years old. Previously in good general health. Developed acute illness with tenesmus and smarting pain in urination. A normal-sized prostate of benign

Fig. 7.

Fig. 8.

Fig. 7. Case 5. The urethrocystogram shows an inflammatory outline of the fundus of the bladder. The postmortem examination showed a chronic spermato-peri-spermatocystitis.

Fig. 8. Patient with a chronic inflammatory process in the hipjoint. The urethrocystogram shows a limited irregularity of outline in the related portion of the bladder.

consistence was palpated *per rectum* (Dr LEANDER), and definite, distinctly tender, infiltration was felt above the prostate, both to the right and the left, from which a urethral secretion consisting of white cells was expressed. A *sample of sperma* contained abundant white cells and some cocci. A *urethrocystogram* on Dec. 15th, 1945 (fig. 5) showed deep irregularities of inflammatory appearance of the outline of the entire fundus of the bladder. *Radiography of the colon* on Dec. 17th, 1945, showed no noteworthy changes. The subjective symptoms subsided after a series of neosalvarsan injections and a second sample of sperma showed no pathologic changes.

Case 4. Male, 54 years old. (Surgical Dept. Record No. 365, 1946.) Gonococcal infection 25 years ago resulting in urethral strictures. Catheterization of the bladder had to be performed in Jan. 1946, on account of acute retention of urine. Admitted to the Caroline Hospital for treatment of the urethral strictures. A *urethrocystogram* was performed on Feb. 9th, 1946 (fig. 6) showing, besides the urethral strictures and prostatic ducts, torulose irregularities of the mucous membrane in the posterior and inferior portion of the urinary bladder. A moderately enlarged prostate with well-defined limits was palpated *per rectum*. No marked tenderness of the prostate. The findings on palpation of the seminal vesicles was not recorded. *Radiography of the colon* on Feb. 9th, 1946 showed nothing remarkable.

Case 5. Male, 74 years old. (Record No. K 1136-45.) Admitted to the surgical clinic for esophageal stricture. A urethrocystogram was performed (fig. 7) on Jan. 10th,

1945, because of cystitis troubles in the form of tenesmus. It showed a cystitic irregularity of the fundus of the bladder. The patient died from an intercurrent disease and at the *postmortem examination*, hypertrophy of the prostate and chronic spermatocystitis and perispermatocystitis were demonstrated.

Thus, 3 of the 5 cases (Nos. 1, 2 and 3) showed clinically distinct symptoms of spermatocystitis; in one case (No. 5) spermatocystitis was diagnosed at the postmortem examination. In case No. 4 the main disease was urethral strictures, and a local change in the posterior portion of the fundus of the bladder was a more or less incidental finding at the urethrocystographic examination. The case may serve as a demonstration of the fact, that spermatocystitis often occurs in conjunction with other diseases of the prostate or the urethra. As these other diseases are the first to draw the attention, the spermatocystitis is overlooked at the clinical examination, despite the fact that, in many cases, it contributes greatly to the subjective complaints of the patient. The local change in the fundus of the bladder varies in appearance in the different cystograms. In cases 3 and 5 the indentations of the mucous membrane is pointed and finely jagged; in cases 1, 2 and 4 it is more knobbed and irregular, especially in case 2 which is particularly interesting. The changes in the posterior portion of the fundus of the bladder were so pronounced that the nature of the process could not be determined with certainty from the urethrocystogram. The possibility of cancer of the bladder could not be entirely eliminated. The nature of the process was first revealed in a radiograph of the colon (fig 4) depicting the typical inflammatory alterations in the rectum. Radiographs of the colon were taken also in 3 of the other cases, but no pathologic changes were recognized. This probably may be explained by the fact that the seminal vesicles, as mentioned above, are not, anatomically, so intimately related to the rectum as to the urinary bladder. The rectal wall is not affected until the perispermatocystitis has reached a more advanced stage, as in case 2.

In connection with these cases of spermatocystitis, another case will be described, where the anatomo-pathological basis for the local cystitic change recognizable by roentgen was identical with that of the above mentioned cases, but where the local cystitis was caused by a chronic inflammatory process in the right hipjoint, of more than 20 years' standing. A urethrocystogram on Dec. 10th, 1945 (fig. 8), showed a limited cystitic alteration of the mucous membrane; on cystoscopic examination (Professor HELLSTRÖM) the mucosa, over an area 3 cm in diameter to the right in the bladder, appeared torulose, swollen, cleft and reddened without sign of a tumor. A remarkable feature is that the inflammatory area had remained limited in spite of the fact that the disease was of long standing.

Spermatocystitis may cause pathologic changes in the ureters as well

Fig. 9. Fig. 10.

Fig. 9. Case 6. Clinical symptoms of spermatocystitis on the right side. A radiograph of the urinary tract shows dilatation of the right renal pelvis and ureter.

Fig. 10. Case 6. The same patient as on fig. 9. Ureterographic examination shows a 4 cm long stricture of the distal portion of the right ureter.

as in the urinary bladder. The statement applies especially to the chronic form when there are hardened and fibrous perivascular infiltrations. In those cases where the ureters, as mentioned above, have an intimate anatomic contact with the seminal vesicles, they may, under such circumstances, become involved in the inflammatory process which may result in stenosis of their distal portion. This form of ureterostenosis caused by spermatocystitis has been mentioned by HERBST, MERRICKS, and others, but has not been given much consideration by roentgenologists. In case 2 described above, radiographs of the urinary tract were taken on Sept. 21st, 1945, and a distinct dilatation of the right renal pelvis and the right ureter, down to the opening into the urinary bladder was observed. The left renal pelvis and ureter were of normal width. As in this case an infiltration was palpated exactly at the site of the right seminal vesicle, it must be presumed that the dilatation of the right ureter was caused by an ureter stricture due to spermatocystitis. This form of ureterostenosis has subsequently been the subject of our attention, and I will mention 3 more cases where it has been observed.

Fig. 11.

Fig. 12.

Fig. 11. Case 7. Clinical symptoms of spermatocystitis, predominant on the left side. A radiograph of the urinary tract shows dilatation of the left renal pelvis and ureter.

Fig. 12. Case 7. The same patient as on fig. 11. Ureterostenosis in the distal portion of the left ureter.

Case 6. Male, 26 years old (Record No. XXI C.) Venereal disease denied. For 7 years periodically severe straining at urination and pains over the right side of the abdomen. On one or two occasions passed gravel in the urine. Control examinations at the Caroline Hospital since Sept. 6th, 1943. On *palpation per rectum* a highly tender, diffuse infiltration was found on different occasions, at the site of the right seminal vesicle; cystoscopic examination revealed a bullous edema in the fundus of the bladder, chiefly localized around the orifice of the right ureter. Radiographs of the urinary tract showed dilatation of the right renal pelvis and ureter. During a period in June 1946 when there was severe straining on urination, a *radiograph of the urinary tract* was again taken on June 6th (fig. 9), showing a distinct dilatation of the right renal pelvis and ureter. No signs of concretion in the kidneys, the ureters or the bladder. On *cystoscopic examination* on June 20th, a pronounced bullous edema particularly marked around the orifice of the right ureter was observed, as before, in the fundus of the bladder. A catheter could be introduced into the latter for a distance of only 2 cm. A subsequent *ureterographic examination* (fig. 10) revealed a 4 cm long stricture in the distal portion of the ureter. Above the stricture the ureter was dilated.

Case 7. Male, 34 years old. (Record No. XXII C.) At the age of 32 virulent gonorrhea attended by severe straining on urination and pains radiating into the penis. Treated in hospitals several times. Since April 28th 1947, control examinations at the

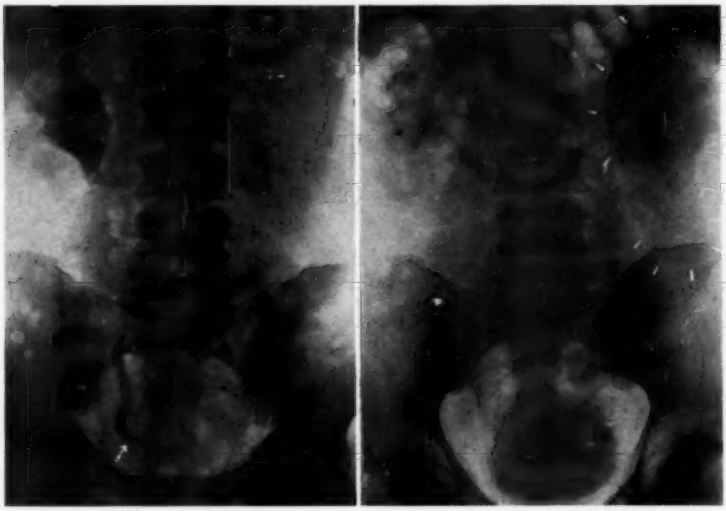


Fig. 13. Fig. 14.

Fig. 13. Case 8. Clinical symptoms of bilateral spermatocystitis. A radiograph of the urinary tract shows dilatation of the right renal pelvis and ureter above a stricture of the distal portion of the ureter.

Fig. 14. Case 8. The same patient as on fig. 13. 4 hours after intravenous injection the radiograph shows a very marked dilatation of the left renal pelvis and ureter.

Caroline Hospital. On *rectal palpation* the prostate appeared to be of normal size with an undefined upper limit. On several occasions two firm, tender strands of more than a finger's breadth, with diffuse outlines, were palpated at the site of the seminal vesicles. *Urethroscopic examination* and probing of the ejaculatory ducts was performed several times, revealing a highly bullous edema to the left in the fundus of the bladder and congestion of the urethral orifice which had a fibrin coating. On probing of the right ejaculatory duct a purulent secretion gushed forth. The whole length of the left ejaculatory duct could not be probed on account of obstructions.

A *radiograph of the urinary tract* on May 5th, 1947, showed dilatation of the left renal pelvis and ureter (fig. 11) down to a point about 1 cm in front of the opening into the bladder, where ureterostenosis was recognized (fig. 12). On the right side conditions were normal.

Case 8. Male, 46 years old. (Record No. XX A.) Gonorrhea at the age of 24. Over a period of 8 years smarting pain and straining accompanied by chill on urining. Also signs of pyelitis with periodic pains, mostly to the left in the abdomen; a high temperature and cloudy urine. Admitted to the Caroline Hospital on March 11th, 1947. *Per rectum:* The prostate and seminal vesicles formed together a hard mass strecthing far to the side and towards the pelvic wall, and with an impalpable upper limit. The mass appeared to be slightly tender.

Cystoscopic examination (ROMANUS) on March 14th showed marked redness and a bullous edema in the trigone and around the internal urethral orifice. A few fibrin coatings. The mucous membrane of the bladder otherwise moderately reddened. The ureteric openings not discernible, nor the openings of the ejaculatory ducts on the colliculus.

A radiograph of the urinary tract on March 13th, 1947 (figs. 13 and 14) showed slight dilatation of the right renal pelvis and ureter above a stricture over the opening into the bladder (fig 13.). The stricture in question was $1^1/_2$ cm in length. The radiograph also showed a very marked dilatation of the left renal pelvis and ureter all the way down to the region of the bladder (fig. 14). There were no signs of concretion in the urinary passages.

On April 29th, 1947 an operation was performed (left-sided nephrectomy and left-sided ureterectomy). The roentgenologic findings were confirmed, dilatation of the renal pelvis and the ureter above a stricture where there were signs of ureteritis being established.

Perhaps we shall find that the above-described form of ureterostenosis is more frequent than has hitherto been realized, if we bear it in mind in cases of dilatation of the renal pelvis and ureter of an otherwise inexplicable nature.

SUMMARY

The author first describes local changes in the posterior portion of the fundus of the bladder, seen in the urethrocystogram. They are caused by spermatocystitis and perispermatocystitis and have not been previously mentioned in the literature. An account is given of 5 such cases. Then follows a description of roentgenologically recognizable stenosis of the distal portion of the ureter in spermatocystitis and perispermatocystitis, with the discussion of 4 illustrative cases.

ZUSAMMENFASSUNG

Erst wird eine auf dem Urethrocystogram sichtbare und in der Literatur bis jetzt nicht erwähnte, begrenzte und entzündliche Reliefveränderung in dem hinteren und unteren Teile der Harnblase beschrieben, welche von Spermato- und Perispermatocystitis verursacht wurde. Verf. berichtet über fünf solche Fälle. Dann wird eine röntgenologisch nachweisbare Stenose in dem distalen Teile des Harnleiters bei Spermato- und Perispermatocystitis erwähnt und vier solche Fälle erörtert.

RÉSUMÉ

Description d'altérations inflammatoires et locales du relief de la partie postérieure du fond de la vessie. Ces altérations visibles sur un uréthrocystogramme, jusqu'ici non mentionnées dans la littérature médicale, sont provoquées par la spermato-périspermatocystite. Cinq cas sont relatés. L'auteur décrit ensuite une sténose, due à la spermato-périspermatocystite, localisée à la partie distale de l'urétère et qu'on peut étudier sur une radiographie. Quatre cas de ce genre sont rapportés.

LITERATURE

1. Bauer, K. H., Zur röntgenologischen Darstellung der Samenwege von der Uret ra aus. Zentralblatt für Chirurgie 54, 1927, Seite 3210.
2. Belfield, W. T. und H. C. Rolnick, Vesiculography by means of jodized o ls. The journal of urology. Vol. 16. 1926.
3. Cunningham, Seminal vesiculitis. Boston med. and surg. journ. Vol. 184 nr. 8 p. 189—194.
4. Dressler, L., Neure Untersuchungen zur röntgeno logischen Darstellung der mä nlichen Harnröhre, Prostata und Samenblase. Fortschritte Röntgenstrahlen. 39. 1929.
5. Edling, N. P. G., Utrethrocystography in the male with special regard to mictu rition. Acta Radiologica. Suppl. LVIII. 1945.
6. Herbst, R. H. and James W. Merricks, Visualization and treatment of seminal vesiculitis by catheterization and dilatation of the ejaculatory ducts. The journal of urology. 41. 1939. p. 733.
7. Martini, M., Röntgendarstellung der Samenblasen am Lebenden. Zeitschrift für urologische Chirurgie. 44. 1938—39. S. 326.
8. Merricks, J. W., The modern conception of the diagnosis and treatment of infections of the seminal vesicles. The New International Clinics. Vol 2. June 1940. p. 193.
9. Puhl, Fortschritte der Röntgenologie und Endoskopie der Harnröhre und der männlichen Genitale. Zbl. Chir. 57. 1930.
10. von Saar, G. F., Chirurgische Beiträge zur Kenntnis der Erkrankungen der Samenblasen. Zeitschrift für Urologie. 8. 1919. S. 295.
11. Schwarzwald, R. Th., Die Samenblasen und ihre Erkrankungen. Handbuch der Urologie. Band 5.
12. Wilhelm, S. F., Vaso-seminal vesiculography. Clinical and experimental application. The journal of urology. 41. p. 751.
13. Voelcker, F., Chirurgie der Samenblasen. Neue Deutsche Chirurgie. Band 2.
14. Young, H. H. and C. Waters, X-ray studies of the seminal vesicles and vasa deferentia after urethroscopic injection of the ejaculatory ducts with thorium. The Amer. Journ. of roentgenol. Vol. 7. 1920.

FRO[illegible] THE ROENTGEN DEPARTMENT OF ST. ERIK's HOSPITAL, STOCKHOLM (CHIEF: DR. C. [illegible]ANDSTRÖM) AND THE SURGICAL DEPARTMENT OF ST. ERIK's HOSPITAL, STOCKHOLM, SWEDEN (CHIEF: DR. E. PERMAN)

JEJUNO-GASTRIC INTUSSUSCEPTION[1]

A Rare Complication of the Operated Stomach

by

Sten Aleman

Troubles of various kinds consecutive to a stomach operation rather frequently lead to a roentgen examination. The examiner may find a peptic jejunal ulcer or accelerated or retarded emptying, but most of the time a cause for the patient's sufferings is not likely to be determined. Intussusception of the jejunum in the vicinity of or through the gastro-enterostomy stoma into the stomach is a complication, which is seldom diagnosed but presumably of practical importance.

Bozzi described the first case in 1914, but it does not appear to have drawn much attention, as in most of the literature priority is ascribed to Steber in 1917. Since then about 70 cases have been described. Only 12 cases are roentgenologically diagnosed — and there are only a few fairly detailed roentgenological descriptions (Gutman & Jobin, Ledoux-Lebard & Garcia Calderon, Lenarduzzi & Bonomini, Zerboni).

Own Case

K. R. W., male, b. 1900. Journal no. 3863—46.

This patient was operated on at Sabbatsberg Hospital, Stockholm, in 1927 because of recurrent duodenal ulcers over a period of 5 years. A stomach resection was done according to Billroth II-Polya with posterior gastro-enterostomy (g. e. p.). The patient was subsequently completely symptom free until 1940, when he was readmitted to Sabbatsberg Hospital. He had become acutely ill several hours after a crayfish dinner at which plenty of strong drinks were served, suffering from nausea, vomiting, and somewhat later, severe, cramplike pains in the epigastrium. These attacks came at 5 to 10 minute intervals and were relieved by vomiting. In the beginning the vomitings contained food, then became bile tinged and finally mixed with blood. The pa-

Submitted for publication, Dec. 15, 1947.

tient had no bowel movement but passed gas. After 3 days of conservative therapy he was symptom-free. Roentgen examination of the abdomen the day the patient entered the hospital showed nothing pathological and a cholecystography several days later revealed only normal conditions. During the first days the patient's urine showed abnormally high diastase content, which prompted the diagnosis »ac. pancreatitis + ac. gastro-enteritis». The patient had no further trouble until June 5, 1946, when he was again admitted to the Surgical Department of St. Erik's Hospital. He had felt ill in the night in exactly the same way as in 1940, but this time without previous excesses of any kind. Except for pain and vomiting he seemed relatively unaffected. His pulse and temperature were normal, his abdomen soft but upon palpation to the left in the epigastrium there was active contraction of the muscles and a marked tenderness. Nothing definite was palpable. There had been no bowel movement since the previous day. Diastase values were normal. — On the basis of the tentative diagnosis of »ileus?» a roentgen examination of the abdomen was made, but it revealed no definitely pathological condition. Since the patient had a brown-coloured vomiting at the Roentgen Department, a bleeding ulcer was suspected and barium given by mouth. Among others, we then obtained the roentgen films here reproduced (Figs. 1 and 2), which led to the diagnosis of »jejuno-gastric intussusception». This was confirmed about an hour later at operation (Dr. F. NILSSON). Approximately 50 cm. of the efferent loop of the jejunum was found invaginated within the stomach. The g. e. site itself was the origin of the intussusceptum. Reduction was accomplished easily and simply by drawing out. The stomach and the duodenal loop were widened; otherwise nothing noteworthy was observed locally. The g. e. stoma was approximately 2 finger breadth wide. Examination of the passage a week or so later showed nothing definitely pathological (Fig. 3). — The patient had a period of pain at the end of October but has had no further trouble since.

Knowing the patient's history, it may be assumed that also in 1940, he had an intussusception, which was spontaneously reduced. The symptoms were exactly the same. Intermittent pains and bloody vomiting are not symptomatic of pancreatitis. The fact that irritation of the pancreas, with increased diastase values, developed, is explained by the circumstance that in an intussusception of this type the duodenum is shut off completely, in this particular case for 3 days. Experiments on animals (BLOND) support this assumption. After stomach resection + g. e. in dogs, BLOND obtained in several cases a retrograde intussusception and in a few a spastic contracture at the g. e. site with necrosis of the fatty tissues.

Different Types of Intussusception, Clinical and Roentgenological Aspect

In the literature, cases of intussusception are divided from a clinical point of view into 2 groups:

1. *Acute*, with typically severe symptoms and grave prognosis;
2. *Chronic*, with more atypical symptoms and ordinarily good prognosis.

Fig. 1. Erect position.

Fig. 2. Prone position.

In group 2 are included those cases which arise in connection with operations and constitute some of the cases grouped under the heading of postoperative gastric ileus.

From the roentgenological point of view there is considerable difference only between cases of:

1. *Simple* intussusception: I and II in Fig. 10, and
2. *Combined* intussusception: III in Fig. 10.

As the following indicates, the clinical and roentgenological groups for the most part coincide.

The history given above is typical for the *acute* cases: extreme nausea and vomiting, the vomitings first containing food, later bile, and finally blood, combined with intermittent, colic-like pains in the epigastrium. These cases are further characterized at the onset by unaffected general condition, with normal pulse and temperature, but gradually the pulse rises. There is some swelling and tenderness to the left in the epigastrium. In 19 cases a tumor has been palpated. Ordinarily there is a bowel movement or at any rate gas is passed during the first 24 hours.

The patient is sent in for roentgen examination with the diagnosis of »ileus?» or of »bleeding ulcer?». Roentgen pictures of the abdomen

Fig. 3. Evacuation. Examination with Erect position c. 1 week after Operation.

Fig. 4. Postmortem Preparation from an Analogous Case at St. Bartholomew's Hospital, London (RIEDEL).

usually show nothing pathological, and certainly no ileus picture, a circumstance which is very misleading inasmuch as an ileus condition actually exists. The explanation is, of course, that the obstruction is so high up. Only in exceptional cases and at an advanced stage does a general ileus appear, probably reflexively induced and of paralytic character.

A barium examination shows the stomach and in simple g. e. the duodenal loop also considerably dilated with stenosal peristalsis. The greater curvature is usually convex cranially and the pylorus segment displaced toward the right. The g. e. stoma is not seen and there is no evacuation through it. These signs are indirect and not typical in themselves.

The striated filling defect, on the other hand, is pathognomonic. Going out from the site of the g. e. stoma, an oval or sausage-shaped filling defect is visible. Across this there are narrow contrast streaks a few mm. apart; when the intussusception is small these lie concentrically around a perpendicular axis, but when it is longer there is more of a fan arrangement (see Figs. 1 and 2). The streaks come, of course, from the collection of the contrast medium between the Kerkring folds. The

Fig. 5. Picture taken in Erect position with small amount of barium (LENARDUZZI & BONOMINI).

finest pictures are obtained with moderate compression and a small amount of barium. In the latter case one sees the mucous folds of the stomach displaced cranially (appearance shown in Fig. 6). In erect position, when the barium has sedimented at the base of the stomach, the intussusceptum may appear above the surface of the barium like a metal wire spiral (Fig. 5).

The *chronic*, or rather, perhaps, chronically intermittent cases appear clinically as a periodical recurrent discomfort characterized by a feeling of fullness in the epigastrium. Vomiting is usual but not as continuous as in the acute cases and almost never mixed with blood. More or less severe, cramp-like pains in the epigastrium are also symptomatic but not always present. The discomfort is nearly always associated with meals and usually passes away after an hour or so. These cases have in common the fact that there is no absolute obstruction which prevents emptying, at any rate not for a longer period.

The problem here may be intussusception of the afferent loop. For natural reasons it cannot be very great; emptying through the efferent loop is usually only moderately obstructed. Or there may be a small intussusception of the efferent loop or a combination of both with retained evacuation or spontaneous reduction after a short time. Judging by the literature, the last-mentioned form is most often diagnosed in these chronic cases. As has been said above, the cases which arise in close connection with operations are usually grouped somewhat improperly under this heading, since almost all of them are of the combined intussusception type. — Dr. E. PERMAN, Stockholm, has been kind enough to let me make use of one case which was undoubtedly of this type, although at the time the fact was not recognized. It is as follows.

Fig. 6.

Fig. 7.

J. N., female, aged 31, had stomach trouble for 5 years. Roentgen examination showed deformation of the duodenal bulb with retention. An operation undertaken January 1924, showed duodenal ulcer. Resection was done according to Billroth II. There were postoperative pains in the epigastrium and retention vomiting. A roentgen examination on April 24 yielded the following pictures, which, judging by the literature, are typical of a combined intussusception. In Fig. 6 one sees how the mucous folds of the stomach are displaced cranially and to the left by the intussusceptum, which is seen more distinctly in Fig. 7, in which the Kerkring folds appear very clearly around a central contrast spot. — A relaparatomy on January 25 showed nothing abnormal. Anastomosis let 2 fingers through. G. e. a. a. was done but the vomiting continued and the patient died February 4. Postmortem examination failed to explain the faulty functioning of the stomach.

Undoubtedly intussusception is relatively seldom diagnosed because, in the chronically intermittent cases at any rate, it is often spontaneously reduced after a comparatively short time. In many cases (*e. g.* GUTMAN & JOBIN) the patients have had difficulty for a long time and have been submitted to repeated roentgen examinations until finally, more or less by chance, the radiogram reveals an intussusception. — This is, of course, due to the fact that these intermittent intussusceptions are induced by meals but not by the indifferent barium. SIBLEY describes a case in which intussusception was spontaneously reduced during fluoroscopic examination. LENARDUZZI & BONOMINI show a fine picture from a case of acute intussusception (Fig. 8) in which none was found upon operation but where one could easily be induced.

Fig. 8. After LENARDUZZI & BONOMINI.

Fig. 9. Picture from a case of cancer of the stomach developed a few years after a g. e. (St. Erik's Hospital).

Differential Diagnosis

Among other things, the formation of folds around the anastomosis is of interest from the point of view of differential diagnosis. These are, however, more irregular and not so sharply differentiated from their surroundings; they are rather in a direct continuity with the rest of the mucous folds of the stomach, instead of displacing them as described above. — Cancer infiltration in the wall of the stomach around the stoma may give a similar picture (Fig. 9), but even here one misses the regularity of the Kerkring folds. — One may even think of impressions from the outside, but if one has in mind the possibility of an intussusception and a clear idea of the picture, diagnosis should not be difficult.

Treatment

The treatment is, of course, surgical as soon as the diagnosis has been made or suspected.

Incidence of Different Types of Intussusception

As has been said, only 70 odd cases are described in the literature. The author has succeeded in obtaining fairly detailed descriptions of 65.

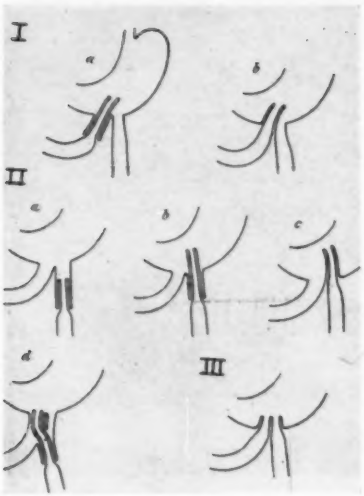


Fig. 10. Diagram showing different types of Intussusception.

These include 3 different types and a number of variations, shown in diagram in Fig. 10.

Type I includes different degrees of intussusception of the afferent loop, a descending intussusception; Type II, intussusception of the efferent loop, an ascending or retrograde intussusception, and finally, Type III is a combined intussusception of both loops. A number of authors are unwilling to call Type III an intussusception at all, seeing in it only a prolapse of the jejunum loop through the g. e. stoma. But since this intussusception has much in common with the other types, both clinically and roentgenologically, it has been included.

Among 58 cases in which the type of invagination is indicated, the distribution is as follows:

I Invaginatio Descendens	6
II Invaginatio Ascendens	43
III Invaginatio Combinata	9

As Fig. 10 shows, the 3 cases in which the invaginated efferent loop passed into the afferent loop through an entero-anastomosis and thence up toward the stomach are included in group II. The only Swedish case which has previously been described in detail belongs here (LUNDBERG). It was not diagnosed until postmortem. BAGER also mentions a case of jejuno-gastric intussusception, but without commentary. With the exception of the Swedish cases (LUNDBERG, BAGER, and the author) in which more or less extensive resection was done, the author has succeeded in finding only 1 similar case in the literature (NAMARA). In all the other cases a simple g. e., possibly plus e. a., has been done. The type of g. e. (g. e. a. or g. e. p.) and the width of the g. e. stoma do not appear to have any definite significance.

Relation to the First Stomach Operation

Combined invagination is usually an early complication diagnosed in 6 cases out of 9 only a few days after the g. e. operation. The other 3 cases were recognized from a few months to 1—2 years afterwards but

the symptoms began consecutive to the operation. Simple intussusception is a typical late complication which develops on the average 6 years after operation.

In all cases except 1, the reason for the first operation was ulcers; in the exception the cause was gastroptosis. The absence of any cancer cases may be ascribed to the fact that they seldom live long after the operation.

Roentgenologically Examined Cases

18 cases, about 50 % simple and 50 % combined intussusception, were examined roentgenologically. In 1 case, only failure of the stomach to empty was discovered. The others showed the typical filling defect, but in at least 3 instances it was wrongly interpreted. In 4 cases operation revealed no intussusception, but the diagnosis appears nonetheless certain (see, for example, Fig. 8).

Naturally from a roentgenological point of view are of interest only those cases in which the apex of the intussusceptum lies within the stomach, making it theoretically possible to obtain the typical striated filling defect. These constitute about 85 % of the total. In the other cases it would be possible merely to diagnose an obstruction of unknown origin to the emptying of the stomach.

Preoperative Diagnosis and Mortality

Except in these roentgenologically diagnosed cases, a correct preoperative diagnosis has been made only occasionally, *i. e.* when an invagination tumor was palpated, as was done in 19 cases. In 1 case of relapse the patient himself made the diagnosis. In most of the other cases high ileus or a bleeding ulcer was suspected. The first mentioned diagnosis usually, of course, leads to a speedy, life-saving operation, while the second one ordinarily prompts more conservative therapy, with deleterious consequences for the patient. The mortality rate is given as 10 % for operations undertaken within 48 hours after the onset of the symptoms and more than 50 % for delayed operations. Hence an early diagnosis is of the greatest importance.

Etiology and Mechanism

The genesis of these intussusceptions and their evolutive mechanism are not clear. In contrast to the situation on other types of intussusception in adults, there is not a single case in which some anatomo-pathological change found in the intussusceptum itself could account for the

genesis of the invagination. Of 300 cases dealt with by ELIOT & CORSADEN, a local pathological change — a tumor, ulceration, or the like, or a Meckel's diverticulum — was found in 66 %.

Thus the cause must be functional.

Most authors assume that a local spasm and antiperistalsis cause the simple, retrograde invagination which is the commonest type. NOHNAGEL and PROPPING succeeded in producing a local spasm and small invagination by stimulating the small intestine with, respectively, faradic current and physostigmine. The initial direction seems to be conditioned by the fact that a more mobile segment of the intestine becomes invaginated in another which is more firmly fixed. The same stimulation which induces the initial invagination is assumed simultaneously to induce an antiperistalsis which pushes the intussusception on in an oral direction. Only ROHDE considers that antiperstalsis need not be assumed, that the peristalsis wave moving in an aboral direction passes over into the outer cylinder of the intussusceptum and thus drives the apex in an oral direction. SCHNELLER has shown that antiperistalsis can occur physiologically even in the small intestine. Undoubtedly the fecal vomiting in, for example, ileus caused by small bands of fibrous adhesions is also due to a retrograde peristalsis.

But if there is a certain agreement concerning the mechanism, opinions concerning the cause widely differ. Usually stimulation of the intestine by some unsuitable element in the diet or by the HCl in the emptied contents of the stomach, especially in so-called »dumping stomach», is assumed. The latter assumption would explain why intussusception is so rare after stomach resection, when HCl secretion is usually considerably reduced. In addition, the counter-pressure against an invagination within the small remaining part of the stomach becomes greater than when all of the stomach, connected as it is with the duodenum, is still present. A reflexively induced spastic condition might well be found in the small intestine as well as in the stomach (SANDSTRÖM). Analogous with the gastrospasm following an injection of morphine which SANDSTRÖM has pointed out are 2 cases of invagination in morphine addicts (SCHWARTZMANN, TUOMIKOSKI). In 1 case trauma appears to have been the cause (SCHLOESSMAN). It seems that certain conditions tend to pave the way for intussusception; these include pregnancy, different types of adhesions, a thick, shrivelled mesocolon, and probably also gastrospasm through fixation of the stomal end of the jejunum. PERMAN stresses the significance of the widening of the upper part of the jejunum which gradually takes place after a g. e. operation. The fact that this widening does not reach its maximum for some time might explain the circumstance that simple invagination is usually a late complication.

The site of the simple invagination must be in the jejunum at some distance from the stomach, since, according to the general opinion (SOUTTAR and others), the intussusceptum grows only at its neck or base, while the apex, because of interference with the circulation by edema, is always formed by the same segment of intestine. The stomach cannot have any direct effect on the progression of the intussusceptum until the latter comes so near the g. e. stoma that first the pressure variations caused by vomiting and later the antiperistalsis of the stomach make themselves felt. The intussusceptum reaches the limit of its power to grow when its base coincides with the g. e. stoma or possibly an e. a. Hence an invagination which occurs near the stomach cannot be very long and is easier to reduce than one originating some distance away.

The mechanism of the so-called combined invagination is probably quite different. Here a gastrospasm or a reduction in pressure due to vomiting are presumably the primary factors, while the intussusception itself is a more secondary, passive prolapse of the loop of the jejunum.

Undoubtedly the reason why these intussusceptions are not more common than the rather scanty casuistics suggests is that a number of factors must operate simultaneously in order to produce them. Furthermore, a relatively large number are reduced spontaneously and never diagnosed.

They would certainly be discovered more often if doctors wore the possibility of intussusception in mind, particularly when dealing with acute abdominal attacks in persons who have previously undergone stomach operations. The examiner would then not be contented with a negative examination of the abdomen but would also make a barium examination if at all possible.

SUMMARY

The author reports on a roentgen-diagnosed case of jejuno-gastric intussusception in a patient previously subjected to a Billroth II stomach resection. The author describes the clinical picture and characteristic roentgenological changes in this form of intussusception, which, judging by the scanty literature on the subject, is very rare. The probable etiology and origin of the intussusception are discussed.

ZUSAMMENFASSUNG

Verf. berichtet über einen röntgenologisch diagnostizierten Fall von jejunogastrischer Intussusception bei einem Kranken, bei dem früher eine Magenresektion nach Billroth II vorgenommen worden war. Verf. beschreibt das klinische Bild und die charakteristischen röntgenologischen Veränderungen bei dieser Form von Intussusception, die, nach dem knappen diesbezüglichen Schrifttum zu urteilen, sehr selten vorkommt. Die wahrscheinliche Ätiologie und die Entstehung der Intussusception werden erörtert.

RÉSUMÉ

L'auteur relate un cas, diagnostiqué radiologiquement, d'invagination jéjuno-gastrique chez un malade opéré antérieurement de résection gastrique selon la méthode de Billroth II. Il décrit le tableau clinique et les signes radiologiques caractéristiques de cette forme d'invagination, qui est très rare à en juger par les données clairsemées de la littérature sur le sujet. Discussion consacrée à l'étiologie et à l'origine probables de cette invagination.

BIBLIOGRAPHY

R = Roentgenologically Examined Cases.

Adams, W.: Brit. Med. Journ. 1, 248, 1935.
Amberger, L.: Zentralbl. f. Chir. 42, 1541, 1921.
Angerer, A.: Zentralbl. f. Chir. 59, 1572, 1932.
Arnsperger, L.: Zentralbl. f. Chir. 49, 190, 1922.
Bachlechner: Zentralbl. f. Chir. 51, 889, 1924.
Bager, B.: Acta Chir. Scand. 64, 1929 Suppl. X.
Baumann, E.: Arch. f. klin. Chir. 111, 504, 1919.
Becker, B. J.: P. South African Med. Journ. 10, 489, 1936.
Bettman, R. B. & Baldwin, R. S.: Journ. Am. Med. Ass. 100, 1228, 1933.
Blond, K.: Arch. f. klin. Chir. 153, 53, 1928.
Bonomi, Br.: Giorn. med. d'Alto Adige 9, 351, 1937. R
v. Brunn, M.: Brun's Beitr. z. klin. Chir. 132, 106, 1924. R
Butler, Wolley & Burton: Radiology 44, 498, 1945. R
Cameron & Macfarlene: Brit. Journ. Surg. 23, 274, 1935—36.
Chamberlain, G. W.: Am. Journ. Surg. 49, 510, 1940. R
Chesterman, J. T.: Brit. Journ. Surg. 21, 541, 1934.
Darling: Med. Journ. Australia 2, 33, 1926.
Debenham, R. K.: Brit. Med. Journ. 1, 250, 1935.
Delfino, E. A.: Deutsch. Zschr. f. Chir. 174, 69, 1922.
Drummond, H.: Brit. Journ. Surg. 11, 79, 1923.
Ducey, E. F. & Mc Namara, W. L.: Ann. Surg. 105, 461, 1937.
Eberle: Zentralbl. f. Chir. 29, 1044, 1923.
Gardaz, E.: Schweiz. Med. Wochenschr. 17, 251, 1936.
Gottesman, J.: Journ. Am. Med. Ass. 106, 1895, 1936.
Greenwood, J. M.: Lancet 1, 256, 1937.
Groper, M. J.: Ann. Surg. 112, 344, 1940.
Gutmann, R. A. & Jobin, P.: Presse Médicale 45, 923, 1937. R
Hartert, W.: Zentralbl. f. Chir. 32, 1154, 1921.
Henschen, C.: Arch. f. klin. Chir. 148, 730, 1927.
Herbert, G.: Lancet 2, 1215, 1932.
Kopp, J. G.: Lyon Chir. 22, 664, 1925.
Ledoux-Lebard, R. & Garcia-Calderon, J.: Arch. des Mal. de l'Appareil digestif 23, 533, 1933. R
Lenarduzzi, G. & Bonomini, B.: Arch. ital. d. Mall. dell'App. dig. 1, 457, 1932. R
Lewisohn, R.: Annals Surg. 76, 543, 1922.
Ljvow, N.: ref. Zentralorg. f. d. ges. Chir. 41, 581, 1928.
Losert, J.: Beitr. z. klin. Chir. 140, 308, 1927.
Lundberg, S.: Acta Chir. Scand. 54, 423, 1922.

N. IABA, W. L.: Annals Surg. 120, 207, 1944.
N. HNAGEL: cit. WANGENSTEEN.
O. RO, J. P.: Boletín de la Soc. de Cir. de Montevideo, ref. Journ. de Chir. 52, 104, 1938.
P. LEGRINI, A.: Rass. internaz. Chir. 403, 1930, ref. Zentralbl. f. Chir. 59, 1407, 1932. R
P. MAN, E.: Acta Chir. Scand. Vol. 77, Suppl. 38, 1935. R
P. RIN, W. S. & LINDSAY, E. C.: Brit. Journ. Surg. 9, 46, 1921.
P. PPING: cit. WANGENSTEEN.
R. SCHAUER, F.: Bruns' Beitr. z. klin. Chir. 144, 671, 1928.
R. DEL: St. Bartholomew's Hosp. Reports 1922, cit. LUNDBERG.
R. IDE, O.: Acta Chir. Scand. 58, 105, 1925.
RUPPANNER: Schweiz. med. Wochenschr. 59, 1237, 1929.
SANDSTRÖM, C.: Acta Radiologica Vol. XXV. Fasc. 5—6. 21: XI 1944.
—, To appear shortly in Acta Radiologica.
SCHILLING, N.: Annals Surg. 95, 958, 1932.
SCHLOESSMAN, H.: Zentralbl. f. Chir. 48, 1538, 1921.
SCHNELLER, F.: cit. TUOMIKOSKI.
SCHWART MANN, E.: Med. Klinik 18, 434, 1919.
SHACKMAN, R.: Brit. Journ. Surg. 27, 475, 1939.
SHEARER, J. P. & PICKFORD, E. M.: Annals Surg. 87, 574, 1928.
SIBLEY, W. L.: Proceed. Staff Meet. Mayo Clin. 9, 364, 1934. R
SOUTTAR, H. S.: cit. WANGENSTEEN.
STEBER: Münch. med. Wochenschr. 20, 648, 1917.
SUMMERS, J. N.: Arch. Surg. J. E. 19, 22, 1929. R
SWARTZ, D.: Canad. Med. Ass. Journ. 20, 172, 1929.
TUOMIKOSKI, V.: Acta Soc. Med. Fenn. »Duodecim» Ser. B 15, 10, 1 1931.
VULLIET, H.: Schweiz. med. Wochenschr. 5, 169, 1924.
WANGENSTEEN, O. H.: Intestinal Obstructions. Publ. by Charles C. Thomas, Springfield, Illinois, U. S. A., p. 399. R
WARREN, R.: Lancet 2, 615, 1919.
WHITE, F. W. & JANKELSON, I. R.: New England Journ. Med. 199, 1189, 1928.
WYDLER, A.: Schweiz. med. Wochenschr. 5, 347, 1924.
ZERBONI, E. R.: Arch. urug. de med. 14, 615, 1939. R

FROM THE ROENTGEN-DIAGNOSTIC DEPARTMENT OF THE CAROLINE HOSPITAL, STOCKHOLM, SWEDEN (CHIEF: PROF. ÅKE ÅKERLUND)

A TYPICAL ROENTGEN PICTURE OF VERY LARGE URETEROCELES[1]

by

Ulf Rudhe

The typical roentgen aspect of ureterocele at urographic examination, has been described by among others VORSCHÜTZ, GOLDBERG, HECKENBAUM, CANIGIANI, HELLSTRÖM and WILLIAMS. Pathognomonic is the drumstick or cobra head appearance of the distal, intravesical end of the ureter. The variations of the outlines of the juxtavesical segment of the ureter in cases of ureterocele have been investigated by HELLSTRÖM. Even in cases lacking contrast excretion, complicated with a calculus in a ureterocele, the diagnosis has been made roentgenologically. The ureterocele wall in these cases appears as a translucent halo around this typically localized calculus. Such cases were published for the first time by ÅKERLUND.

These pictures, described as typical of ureteroceles, however, are significant only for ureteroceles of small or moderate size.

Very large ureteroceles, occupying an important part of the bladder and with the corresponding ureter and pelvis draining insignificantly functioning kidney parenchyma or connected with an entirely functionless kidney, are apparently not described in roentgenological literature. On the other hand, such roentgen pictures are to be found in different publications, where the clinical point of view has been stressed. Such reports have been published by many authors, amongst whom HERRICK, LAZARUS, SARGENT, EMMET & LOGAN, BIRDSALL with co-workers and CAMPBELL.

During the years of 1946—47 3 cases of very large ureteroceles have been observed at the Roentgendiagnostic department of the Caroline Hospital. The diagnosis were confirmed at cystoscopy or operation.

As the roentgen pictures of such cases appear to be little known, the cases have been considered worthy of a description from a roentgenological point of view.

[1] Submitted for publication, Dec. 1, 1947.

Fig. 1

Fig. 2

Case 1. ♀ 11 months. For the past six months occasional fever peaks. Urine examination: Positive bacterial findings in repeated cultures. Heller: Traces to pos. Several white blood corpuscles. Urography: Signs of double pelves of the left kidney. Evidently, there is a separate pelvis with corresponding ureter in the upper segment of the kidney. These structures not visualized on account of lacking excretion in this segment. (Fig. 1.) On the bladder picture (fig. 2), there is a rounded soft tissue formation, almost filling the bladder and apparently taking its origin from the bladder bottom. The distal ureteral ends are angulated, and by its size, the large soft tissue structure causes an elevation of the ureteral orifices. The picture presents consequently a typical bilateral »hook phenomenon».

Operation (HELLSTRÖM) revealed a large ureterocele in connection with a dilated ureter on the left side.

Case 2. ♀ 28 years. Since the age of 15, cystitis symptoms now and then. Lately back pains and for some days fever peaks with chills.

Urine examination: Gram neg. bacilli and cocci and a great number of white blood corpuscles in the sediment.

Urography: Double pelves on the right side. Hardly discernible excretion in the upper pelvis which is dilated. Lower pelvis with corresponding ureter and left side normal findings.

Bladder picture (fig. 4. The picture originating from a later urography. Barium contrast in colon). A rounded soft tissue formation, the size of a hen's egg, is noted bulging into the bladder and situated immediately in line with the intravesical end of a not visualized ureter from the upper pelvis on the right side. The structure is explained by a ureterocele.

Operation (HELLSTRÖM) confirmed the diagnosis.

Case 3. ♂ 25 years. Since 3 years periodical burning at urination and frequency, cloudy urine and grayish white urethral discharge. Last year low back pain. Urine: Hellers: +, Bacterias: +, Gram neg. bacilli. A great number of red blood corpuscles and masses of pus cells.

Urethrocystography (fig. 5): Rounded soft tissue formation, the size of a hen's egg, bulging into the bladder from the bladder bottom behind the urethra. The posterior

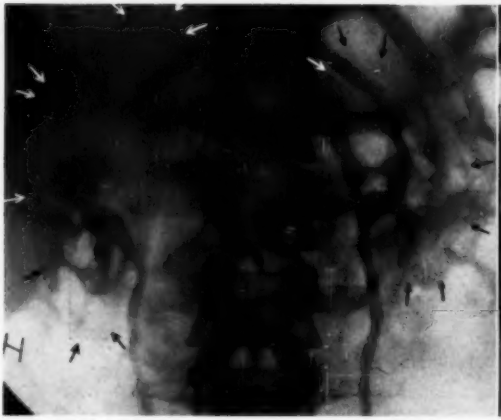


Fig. 3

Fig. 4

Fig. 5

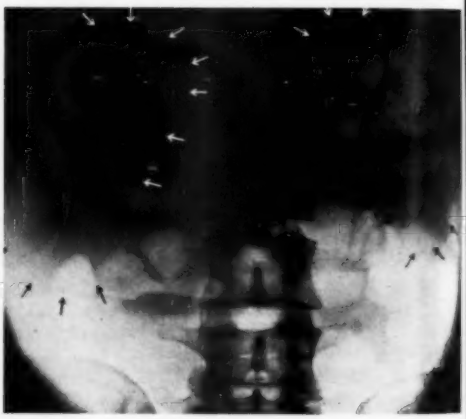


Fig. 6

urethra not deformed. Urography (fig. 6): Double pelves on both sides. On the right side no contrast filling of the upper pole of the kidney, which is locally enlarged — this is explained by a partial hydronephrosis. Lower pelvis on the same side presents normal findings. On the left side the ureters fuse at the level of the lower pole of the kidney. Bladder pictures (figs. 7—8): By its size, the ureterocele causes an elevation of the angulated distal ureteral ends bilaterally. Also slight stasis in the lower part of the ureter, belonging to the lower pelvis on the right side.

Cystoscopy and operation (HELLSTRÖM) confirmed the diagnosis.

Fig. 7

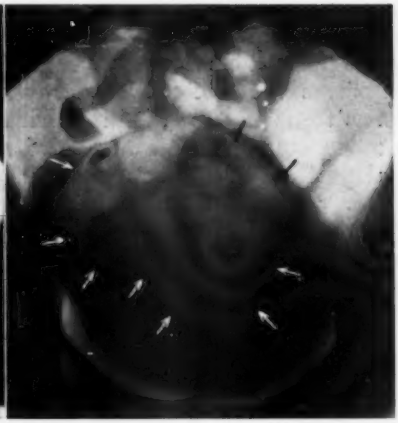


Fig. 8

These ureteroceles thus appear at urography and in one of the cases also at urethrocystography as large, rounded, distinctly outlined soft tissue formations, causing corresponding defects in the bladder contrast. The resemblance with the picture of prostatic hypertrophy of the intravesical adenoma type is marked in the first and third case, not only because of their shape but also of their intimate relation to the bladder bottom. In the second case, the picture reminds of prostatic hypertrophy, too, though the similarity is not so evident on account of the lateral position of the ureterocele.

In addition, in two of the cases, the distal ends of the ureters are angulated in the shape of a hook and the ureteral orifices are elevated, presenting an appearance which has earlier been described as typical of prostatic hypertrophy with adenoma bulging into the bladder.

In these 3 cases, the diagnosis of prostatic hypertrophy, of course, on account of the sex and age of the patients is to be excluded.

It is interesting to note, that there were no signs of trabeculation of the bladder wall.

In cases of prostatic hypertrophy with adenomas of this size — which postulates a long anamnesis — one finds as a rule the bladder wall trabeculated as a consequence of the chronic obstacle to emptying.

However, in cases of ureterocele, it is not uncommon to find such trabeculation, a fact which has been especially emphasized by GUTIERREZ. The ureterocele on account of its considerable size reaches the internal vesical orifice and acting as a valve in the bladder outlet, results in

emptying difficulties. In male patients after middle age the diagnosis then may be difficult.

As is pointed out further, the presence of anomalies, especially double renal pelves and ureters is rather common in cases of ureterocele. If this happens to be the case, it may add to the probability of this diagnosis. The occurrence of unilateral stasis is also in favour of ureterocele as is a lateral position of the structure in question.

At any rate, the absence of trabeculation strongly suggests ureterocele and this diagnosis may be regarded as almost certain in male patients before middle age, females or children.

In these 3 cases, completely reduplicated renal pelves and ureters are found on the same side as the ureteroceles. The ureteroceles have involved the ureters belonging to the upper pelves. Stenosis at the intravesical ureteral orifice has brought about dilatation of the ureter and upper renal pelvis and finally resulted in completely or almost completely abolished function of the kidney parenchyma.

The fairly common co-existence of anomalies of the urinary tract, as mentioned above, is well known. Single cases with double pelves and ureters were described as early as the nineteenth century by LILIENFELD WRANY, BOSTROEM and GEERDTS.

The literature, however, affords only few reports of the intimate relation of the ureterocele to the reduplicated ureters.

HELLSTRÖM, in 1932, reporting 7 cases of ureterocele, found double renal pelves and ureters in 4 cases. In 2 of these, the ureterocele belonged to the ureter from the upper pelvis; in the third case it was possibly so and in the fourth case no statement could be done.

GOYANNA and GREENE found out 2 cases of ureterocele among 131 patients with double renal pelves and ureters. One occurred unilaterally and the other bilaterally. In both cases they involved the ureter of the upper pelvis.

CAMPBELL, in the article on ureteroceles, illustrates 4 such cases. This author did not establish the relationship in a fifth case.

Otherwise, there apparently exist in the literature only reports of single cases (LECHLER, LILIENFELD, WRANY, BOSTROEM, GEERDTS, YOUNG, UGLEW, RØVIG, GREENE) all disclosing the same rule.

Since the opening of the Caroline Hospital 7 years ago, 24 patients with ureteroceles have been investigated.

Table

Double pelves and ureters		Single pelves and ureters		Total
Ureteroceles		Ureteroceles		
Unilat.	Bilat.	Unilat.	Bilat.	
6	1	8	9	24

Of these, including the three very large ureteroceles quoted above, 7 cases revealed completely reduplicated renal pelves and ureters, in one case bilaterally.

In 6 of these, the roentgen pictures are of such quality as to confirm the rule without further evidence. In the seventh case the ureters are not filled with contrast to an extent adequate enough to allow a final conclusion as to the localization.

It has been established, however, that where double renal pelves and ureters occur with both the ureteral orifices situated intravesically, the ureter from the upper pelvis opens medially and caudally of the ureter from the lower pelvis. On the Continent this is called MEYER-WEIGERT's law. (See schematical figure.) This is the finding in the seventh case. Here, there is consequently the greatest possibility that the ureterocele has affected the ureter from the upper pelvis.

As a conclusion, when reviewing the datas concerning the uretroceles observed at the Caroline Hospital and the reports in the literature, *the ureteroceles in cases with coexisting complete reduplication of renal pelves and ureters as a rule seem to affect the ureter from the upper pelvis.* No certain exception has been recognized.

SUMMARY

The author describes the roentgen picture of 3 cases of very large ureteroceles and calls attention to the resemblance with that of prostate hypertrophy. Especially in the case of children, female patients or men before middle age showing the appearances described, the presence of a large ureterocele must be considered. In cases of ureterocele double pelves and ureters are often present. As a rule, the uretetocele involves in such cases the ureter connected with the upper pelvis. With ureteroceles of the size described above, on account of the considerable disturbance of the function, one must postulate that the parenchyma within the corresponding segment of the kidney has a reduced or abolished power of excretion.

ZUSAMMENFASSUNG

Verf. beschreibt das Röntgenbild bei 3 Fällen von sehr grossem Ureterozele und macht auf seine Ähnlichkeit mit demjenigen der Prostatahypertrophie aufmerksam. Besonders wenn es sich um Kinder, weibliche Patienten oder Männer in jüngerem Alter handelt, die das beschriebene Bild aufweisen, ist an das Vorliegen eines grossen Ureterozeles zu denken. Bei Ureterozelen liegen oft doppelte Nierenbecken und Harnleiter vor. In der Regel sitzt das Ureterozele in solchen Fällen in dem zu dem oberen Nierenbecken gehörenden Harnleiter. Bei Ureterozelen der oben beschriebenen Grösse ist wegen der bedeutenden Funktionsstörung anzunehmen, dass das Parenchym des betreffenden Nierensegments herabgesetzte oder aufgehobene Ausscheidungsfähigkeit aufweist.

RÉSUMÉ

L'auteur décrit les images radiologiques de 3 cas de très grandes urétérocèles, et attire l'attention sur leur ressemblance avec celles de l'hypertrophie prostatique. C'est surtout chez les enfants, les malades du sexe féminin ou les hommes avant l'âge moyen de la vie que des aspects comme ceux qui sont décrits doivent faire envisager l'existence d'une urétérocèle volumineuse. Dans cette affection il y a souvent doubles bassinets et urétères. En pareil cas l'urétérocèle atteint, dans la règle, l'urétère attaché au bassinet supérieur. En présence d'urétérocèles des dimensions décrites plus haut, il faut admettre que le segment correspondant du rein n'a plus qu'un pouvoir d'excrétion réduit, voire nul, à cause du trouble considérable de la fonction qu'entraîne la lésion.

REFERENCES

Birdsall, J., Tauber, R., Clofine, M., & Lee, B.: Clinics. 3: 58: 1944/45.
Bostroem, E.: Beiträge z. Pathologisch. Anat. d. Nieren. Heft I. Freiburg und Tübingen. 1884.
Campbell, M.: J. of Urology. 45: 598: 1941.
Canigiani, Th.: Z. f. urol. Chir. 36: 172: 1932/33.
Emmet, J. & Logan, G.: J. of Urology. 51: 19: 1944.
Geerdts: Inaug. Dissertat. Kiel. 1887.
Goldberg, V.: Z. f. urol. Chir. 35: 1: 1932.
Goyanna, R. & Greene, L.: J. of Urology. 54: 1: 1945.
Greene, L.: Surg. Clin. of North America. Lahey Clinic Number. 24: 910: 1944.
Gutierrez, R.: Surg. Gyn. and Obst. 68: 611: 1939.
Heckenbach, W.: Z. f. urol. Chir. 35: 34: 1932.
Hellström, J.: Acta Chir. Scand. 71: 339: 1932.
—, Acta Radiologica. 18: 141: 1937.
Herrick, F.: J. of Urology. 35: 643: 1936.
Lazarus, J.: J. of Urology. 36: 139: 1936.
Lechler. Medicinisches Corresp. Blatt d. würtemberg. ärztl. Vereins. 4: 23: 1835.
Lilienfeld: Beiträge z. Morphol. und Entwickel. Geschichte d. Geschlechtsorgane. Dissert. Marburg. 1856.
Røvig, G.: Norsk Magasin f. Lægevidenskapen. 1068: 1935.
Sargent, J.: J. of urology. 35: 499: 1936.
Uglew, R.: Z. f. Urologie. 24: 582: 1930.
Vorschütz, J.: Zbl. f. Chir. 450: 1932.
Williams, R.: Brith. J. of Radiology. 9: 59: 1936.
Wrany: Patholog.-anatom. Mitteilung. Oesterreichische Jahrbücher f. Pädiatrik. Neue Folge. 1: 107: 1870.
Young's Practice of Urology. Vol. II. 46: 1926.
Åkerlund, Å.: Acta Radiologica. 16: 39: 1935.

INSTITUT UNIVERSITAIRE DE RADIOLOGIE MÉDICALE, GENÈVE, SUISSE
(DIR.: PROF. R. GILBERT)

CONTRIBUTION A L'ÉTUDE RADIOLOGIQUE DES MODIFICATIONS OSSEUSES ET CUTANÉES CONCOMITANTES DANS LA RÉGION DES JAMBES[1]

par

René Gilbert et *Georges Voluter*

Dans la région des jambes, les réactions de l'os, concomitantes à un processus des parties molles superficielles et profondes, sont connues de longue date.

Toutefois nous ne savons pas encore clairement quelle est la lésion primitive. Il peut certainement exister, à partir de la cause, des effets émanant tantôt de la peau, tantôt de l'os. Et l'os est pourtant un tissu résistant; dans les panaris, on observe parfois son intégrité malgré d'énormes destructions des parties molles.

Les directions peau—os et os—peau de l'irritation ne sont probablement pas seules en cause. Un désordre à distance pourrait très bien agir, par voie de conséquence, dans le même sens: par exemple un trouble de tout le territoire d'irrigation périphérique — ou de son centre dynamique, le coeur — engendrant des troubles circulatoires locaux. (KÉMERI).

D'autre part, l'altération cutanée ou osseuse pourrait être due simultanément à une lésion locale du système trophique, d'origine mécanique, inflammatoire et vaso-motrice, artérielle, veineuse ou nerveuse.

La complexité de ce problème de physiopathologie osseuse est évidente, preuve en soit les nombreux auteurs qui se sont astrients à l'étudier depuis l'important travail de NOBL en 1918.

Travaux antérieurs. — Le problème est né des considérations sur le complexe variqueux. Le chiffre initial des complications osseuses relevé

[1] Nous tenons à exprimer toute notre gratitude au Professeur W. JADASSOHN, Directeur de la Clinique Dermatologique de l'Université de Genève. Les malades, dont les lésions osseuses sont décrites dans ce travail, nous ont été adressés par lui.

Manuscrit reçu le 18 Décembre 1947.

alors était de 20 %; chiffre qui, à notre avis, aurait été supérieur si la radiographie à l'époque avait pu offrir les détails de structure auxquels nous sommes habitués actuellement; les images radiologiques n'étaient interprétées en effet que sur la base d'altérations relativement grossières. Cependant un fait capital fut relevé: la périostite ossifiante des os longs.

Second fait acquis: observation de ponts osseux dans les lésions importantes des téguments; on nota entre autres des ossifications du ligament interosseux.

L'idée que la lésion cutanée pourrait être secondaire à la lésion osseuse fut déjà soulevée. KLAPP a vu des modifications de l'os dans des troubles cutanés relativement aigus et de peu d'importance, et dans des eczémas dont l'action en profondeur, selon lui, aurait été minime (de là le soupçon d'un trouble osseux d'origine cutanée). Mais il découvrit aussi des »périostoses» sans troubles apparents des téguments sus-jacents. Il admit donc que l'os puisse être le point de départ de la lésion de la peau: opinion partagée par certains auteurs — ce qui n'écarte d'ailleurs pas la thèse du point de départ cutané de modifications osseuses sous-jacentes.

BERDE a évoqué la possibilité d'un désordre généralisé, intéressant les systèmes osseux et tégumentaire. Dans ce désordre, le siège primitif de la manifestation morbide aurait pu être soit dans la peau, soit dans l'os, soit dans les deux. Le parallélisme des lésions ne subirait finalement que des entorses chronologiques pour se manifester soit sur l'un, soit sur l'autre plan. Le même auteur pense également à l'éventualité d'une affection systématisée sur une plus vaste échelle (tissu adipeux etc.).

Envisageons pour commencer le problème de l'affection cutanée, déclenchante de la réaction osseuse. Quels seraient les mécanismes en jeu?

JÖRIMANN, dans une publication succincte, passe en revue les opinions régnantes: lymphangite profonde issue de l'ulcération de la peau (AIEVOLI); invasion, jusque dans les profondeurs des vaisseaux osseux, d'éléments bacillaires à travers les voies lymphatiques (MORRIS); rétention de matières liquides dans le district variqueux (FREY); troubles du métabolisme et formation de poisons métaboliques (KLAPP); stase veineuse et lymphatique compliquées par la présence de certains microbes (BILLROTH); enfin effets irritatifs émanant de la présence de streptocoques et de staphylocoques (GUSZMANN).

Les lésions cutanées (observées et publiées) capables de déclencher dans l'os sous-jacent le syndrome de la périostose et de la symphyse interosseuse, donc un mode réactionnel nettement défini et toujours semblable, sont issues presque toutes du complexe variqueux. L'éléphantiasis, symptôme de stase veineuse et lymphatique, et enfin la tuberculose cutanée et ses acolytes, sont également mis en cause.

JAEGER, au congrès Suisse de dermatologie (Genève 1947), vient de montrer, à propos des complications variqueuses, un cliché radiologique

sur lequel la démarcation de la lésion cutanée correspondait aux limites de la périostose sous-jacente. Cela suggère une interdépendance. Nous reviendrons sur cette constatation.

Si l'on se propose de dépister les premiers stades de la réponse donnée par l'os à l'irritation de la peau, on s'aperçoit qu'il y a très souvent une discordance entre l'importance de la lésion déclenchante à la surface et les effets profonds et vice versa.

L'analyse radiologique de l'os, dans les altérations supposées initiales, est des plus difficiles, car déjà à l'état normal la structure osseuse et sa minéralisation peuvent présenter des variations notables (constitution générale, âge, milieu, nourriture, profession, activité sportive, etc.). On est donc tenté de rapporter la moindre modification à une influence qui pourrait en outre dériver de ces facteurs.

Les constatations de Liechti et Jörimann. — LIECHTI et ses collaborateurs, dans la publication de JÖRIMANN, ont décrit le processus osseux au sommet de ses manifestations.

Première observation: Homme de 60 ans, souffrant depuis vingt ans de vastes ulcères variqueux chroniques des deux jambes. Voici le résultat de l'analyse radiologique d'après le texte original:

Les deux tibias et péronés présentent des appositions périostées, plus ou moins intenses et irrégulières: appositions partiellement étagées, et plus épaisses dans les portions distales que dans les parties proximales. L'on trouve une lisière particulièrement large dans le segment métaphysaire médian du tibia droit. Les auteurs interprètent ces images comme étant à la base d'une périostose généralisée des deux os, dans les deux jambes.

Les radiologistes bernois ajoutent quelques considérations sur l'origine et la nature de ces modifications: pareilles périostoses se voient dans les états morbides les plus variés: elles sont caractéristiques dans la leucémie, dans la syphilis congénitale et enfin dans l'ostéite hypertrophiante toxique. Dans les deux premières éventualités l'image n'est pas typique; car dans leur cas les lamelles d'apposition sont plutôt régulières et concentriques. Quant à l'ostéite hypertrophiante toxique, la périostose s'y produit sous l'effet de stase; elle a une prédilection pour la localisation *diaphysaire*. Or les images provenant de leur cas montrent une *périostose spécialement développée dans les portions métaphysaires*.

LIECHTI et ses collaborateurs pensent encore que cette périostose peut se développer sous l'influence de l'inflammation située dans les parties molles avoisinantes; les ombres radiographiques de celles-ci sont en tout cas plus accusées que normalement (varices, stase?).

Deuxième observation: il s'agit d'ulcères importants, typiquement tuberculeux, de la jambe droite. La radiographie ne révèle pourtant qu'une modification médiocre du péroné seul. Le tibia semble exempt de toute

altération. Il s'agit de modifications périostées dans le tiers inférieur du péroné. En quelques endroits la compacte est une fois amincie, une fois épaissie. Le périoste est nettement détaché, surtout sur le bord externe. (La fente basale est donc encore nettement visible, ce qui plaide pour un processus plutôt récent: voir plus loin.)

La *troisième observation* a, du point de vue radiologique, un intérêt tout spécial. Malade de moins de 36 ans, porteuse, depuis l'âge de 13 ans, d'un érythème ulcéré de Bazin (l'auteur ne dit pas de quel côté). La radiographie des os du côté de la jambe atteinte montre que le tibia et le péroné sont siège d'appositions périostées importantes, surtout dans les portions diaphysaires; la substance osseuse (tibia surtout) est siège de processus sclérosants intenses. Fait plus intéressant encore: *les os de l'autre jambe (exempte de toute altération cutanée) sont également modifiés dans le même sens, mais plus discrètement.* (C'est le péroné qui, des deux os, est ici le plus atteint.) Cette constatation a pu paraître négligeable à l'auteur, car il ne la mentionne pas spécialement; à notre avis, elle est de grand intérêt dans la discussion de la précession cutanée ou osseuse des lésions.

Une autre remarque dans cette observation a attiré notre attention: cet érythème de Bazin a été si grave qu'on a songé à une amputation du membre. La malade s'y étant refusée, une cure de repos absolu a eu un heureux effet (accalmie puis cicatrisation relative de la lésion).

Au sujet de cette immobilisation, ouvrons une parenthèse. Il est probable que dans un syndrome ostéo-cutané, les lésions artérielles soient partiellement ou fondamentalement en cause. Or, d'après les constatations de LIAN, LAVENNA et VON ROTEN, toute artère modifiée par un processus artéritique, engendre, à l'effort, des troubles d'irrigation notable. Les oscillations et la tension diminuent au fur et à mesure que le processus s'accuse. Pourquoi? Deux hypothèses se présentent à l'esprit: un spasme déclenché par l'effort; ou la simple diminution passive de l'apport sanguin (HUSTIN): lors de l'effort, le sang serait retenu par les muscles de la partie proximale du membre. La diminution tensionnelle et oscillométrique à l'effort, chez les artéritiques, serait due, initialement, à la diminution passive de l'apport sanguin dans la partie distale du membre; un spasme secondaire accentuerait l'ischémie.

Cette ischémie est naturellement contraire à toute tendance régressive du processus cutané et osseux. D'où l'effet salutaire de l'immobilisation sur la réparation du processus morbide.

Bases physio-pathologiques de la réaction du périoste

D'abord quelques remarques pour la compréhension des mécanismes pathologiques du tissu osseux, avant d'interpréter les signes radio-morphologiques.

Le périoste est constitué par une membrane conjonctive invisible aux R. X. à l'état normal; même soulevé par une poche de sang ou de pus, il ne se distingue pas des parties molles. Ce n'est qu'en cas d'ossification, ou d'organisation minérale, qu'il se dessine sur le film. De plus

toute phase initiale de réaction périostée et de périostite est invisible à la radiographie.

Dans les réparations de l'os malade, ou en cas de fracture, le périoste se comporte, *histologiquement*, comme le cal vis-à-vis des rayons Roentgen. *Première phase:* formation d'un réticulum de trabécules ostéoïdes, donc sans participation de calcium. Puis transformation du réticulum trabéculaire en trabécules osseux véritables, ce qui, après une vingtaine de jours, rend ces derniers perceptibles à la radiographie. *Deuxième phase:* Le bord, une fois ossifié, est formé d'une masse poreuse, lâche, qui, sur la coupe anatomique, est composée d'épines, de dalles et de feuilles: le tout s'appelle ostéophyte. Celui-ci peut entourer un os long à la manière d'un anneau, ou d'une manchette (selon sa largeur): radiologiquement, on parle d'une manchette ostéophytique. *Macroscopiquement*, le bourgeon initial, à surface irrégulière, n'a pas de caractère radiomorphologique déterminé. C'est une masse spongieuse et floue qui se confond aisément avec les parties molles environnantes. Il lui manque une membrane osseuse de démarcation. Ce n'est qu'après 2—3 semaines que l'ostéophyte, ainsi développé, s'entoure d'un manteau osseux extrêmement fin et devient apparent. A ce moment le bourgeon acquiert une surface uniformément lisse. Mais sa structure intérieure entièrement homogène est parfois nuageuse. Çà et là, l'on devine un dessin strié, cependant flou. Il faut voir tout cela à la loupe. Vers le même moment, le film montre la formation d'une lisière claire entre l'ostéophyte et l'os. Celle-ci provient du fait que la prolifération périostée n'est que très peu »couchée» sur la surface osseuse sous-jacente. Il n'y a là que quelques rares ponts trabéculaires.C'est pourquoi, à cet état, il est facile de détacher, chirurgicalement, le bourgeon de sa plateforme osseuse. *Troisième phase:* Au cours des semaines suivantes, densification de l'ostéophyte, qui prend l'aspect de la masse compacte de l'os et se confond bientôt avec elle. Si, quelques mois après, nous cherchons à fixer son image sur le film, nous n'apercevons qu'une densification de la corticale de l'os. La formation périostée autonome disparaît entièrement.

Dans les états inflammatoires aigus du périoste, donc dans la périostite proprement dite, ce processus ostéophytaire n'est que passager. Après la disparition de la cause d'irritation, il cesse d'exister. Dans ces conditions, il n'atteint jamais »l'état compact», car il se résorbe à temps.

En cas d'irritation chronique, de caractère récidivant, spécifique ou non, les conditions sont tout autres. Nous voyons alors surgir un ostéophyte à base large, en forme de bande, à lamelles superposées à la manière d'une couche géologique. Chaque lamelle correspond à une poussée phasique. Et l'état compact, préliminaire et intercurrent, d'une manchette est transformé en un état spongieux au fur et à mesure qu'à une couche s'en ajoute une autre. Radiologiquement, ce processus se traduit par l'image dite en »pâte feuilletée».

Fig. 1. Ostéoporose en »perle de verre» de la malléole péronière g. Périostose linéaire du bord externe de la diaphyse, s'amincissant en »lames de ressort» vers la portion épiphysaire. — *Homme de 37 ans.* Phlébite il y a 3 ans. Depuis, paquets variqueux du mollet g. Oedème malléolaire le soir. Pas d'ulcère de la peau.

Les signes radiologiques fondamentaux de l'altération osseuse

Ces signes sont les suivants:

1. Modifications de la forme et de la structure.
2. Ossification des ligaments interosseux et dépôts calcaires (voire ossification dans les parties molles adjacentes: tendons, muscles, veines-phlébolithes).

Ainsi trouvons-nous juxtaposées, ou successivement étagées: l'ostéoporose, l'ostéosclérose, la périostose, et la calcification pathologique dans les parties molles; elles peuvent évoluer de façon continue, ou par poussées successives.

Il y a peut-être des moments où les mécanismes de résorption sont prépondérants, d'autres où la néoformation est au premier plan. Cette alternative peut être imposée par des stimuli locaux; elle peut se faire également sous l'action d'influences lointaines multiples. Il y a là certainement un enchevêtrement de causes et d'effets qui peuvent varier selon les constitutions individuelles dans le domaine endocrinien et dans le domaine neuro-végétatif (dystrophies, etc.).

Dans le cas des malades âgés, le canevas osseux de fond est, quant au mécanisme réactionnel local et général, un état d'atrophie sénile relatif. Celui-ci constitue en lui-même déjà un syndrome complexe dans l'involution physiologique. Nous y rencontrons des ostéoporoses plus ou moins précoces, qui peuvent même être accompagnées d'ostéolyse. Se surajoutent, dans les mêmes conditions, des processus de périostose et d'ostéosclérose. Certaines images radiologiques peuvent être qualifiées d'atrophiques-hypertrophiques.

L'étendue et l'intensité du processus est probablement la résultante de la chronicité de l'altération de base. Celle-ci, selon toute vraisemblance, est la stase veineuse. D'après le diapason réactionnel de l'un ou de l'autre,

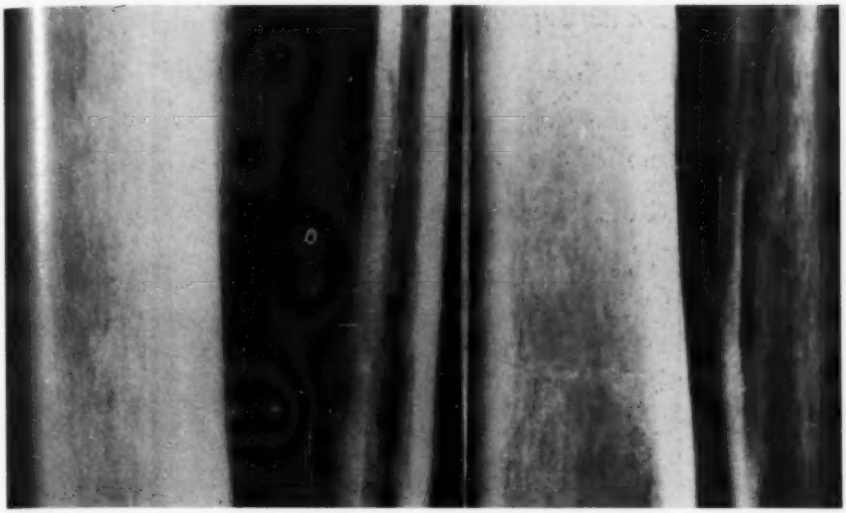


Fig. 2. Fig. 3.

Fig. 2. Périostose du »type cotonneux» du bord externe de la diaphyse médiane du tibia, et du bord interne de la diaphyse médiane du péroné. — *Femme de 53 ans.* Ulcère variqueux depuis 4 ans, à la face supra-malléolaire interne. La réaction osseuse au siège de l'ulcère est minime.

Fig. 3. Périostose du »type éburnisant» du bord externe de la diaphyse tibiale. Corticale à peine élargie. Ébauche d'une travée transverse sclérosée. Périostose en »pâte feuilletée» du péroné. — *Femme de 60 ans.* Ulcères variqueux multiples, confluents, de la jambe gauche depuis 17 ans.

c'est d'un côté la peau et les parties molles, de l'autre l'os, qui manifesteront le premier désordre. Nous croyons que, dans l'ulcère variqueux, ce sont les lésions de l'os qui sont les premières visibles sur la radiographie; elles précèdent celles de la peau *visibles* à l'oeil nu. *Du moins est-ce à ce niveau que nous pourrons constater le premier symptome bio-clinique.*[1]

Cette hypothèse est basée sur le fait que dans le syndrome variqueux, non compliqué d'ulcère, des modifications osseuses sont visibles, cependant que des altérations dystrophiques peuvent exister dans la peau, et peut-être même précéder l'altération osseuse; mais elles ne sont pas encore visibles, ou ne se manifestent pas suffisamment pour être re-

[1] Par le terme *bio-clinique* (créé par PAGEL), nous entendons spécifier l'ensemble des signes cliniques et des modifications radio-morphologiques, comme, dans d'autres cas, l'ensemble signes cliniques, modifications radiologiques, données anatomo-pathologiques.

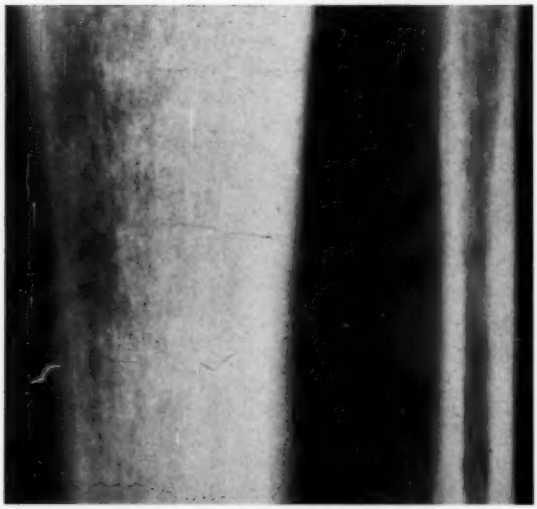


Fig. 4. Périostose du »type neige fondante» de la portion supéro-moyenne du tibia gauche. Périostose symétrique du segment correspondant du péroné. — *Homme de 49 ans*, souffrant depuis des années d'un *ulcus cruris* plaqué contre le bord antérieur de la jambe. Les altérations osseuses dépassent de loin la topographie de l'ulcère.

connues. Nous mettons expressément l'accent sur le mot *visible*, pour ne pas donner l'impression d'imputer à l'os la priorité de la réaction.

Si dans un ulcère variqueux compliqué d'altération osseuse, nous examinons la jambe »normale», nous y découvrons chaque fois des modifications, discrètes ou marquées, soit du périoste, soit de la compacte. Les deux altérations peuvent survenir simultanément. La phase initiale du processus osseux est peut-être peu reconnaissable à la radiographie; nous ne la saisissons pas d'emblée; mais il se peut aussi que ce soient les parties molles, et spécialement les muscles, qui se modifient avant l'os et avant la peau.

Un autre fait qui semble étayer notre conception est le suivant: S'il s'agit d'une lésion de la peau (tuberculose p. ex.) sans relation immédiate avec le syndrome variqueux, il y a discordance entre la gravité et l'étendue de la lésion cutanée, et l'intensité de la réaction osseuse. Cette discordance a déjà été signalée par JÖRIMANN, radiographie à l'appui, dans un cas de tuberculose cutanée très étendue de la jambe.

Deux remarques de R. Leriche. — Une périostose est une ossification périostée exagérée; par cela elle est le contraire de ce qu'on appelle ostéolyse. Ses causes sont nombreuses. Elles constituent toutes une irritation

Fig. 5. Périostose du »type éburnisant», ondulée, du tibia, et ostéoporose striée du bord adjacent du péroné. Tout le bord externe présente par contre une périostose homogène. Lésions symétriques des deux jambes. — *Femme de 68 ans. Ulci cruris* bilatéraux chroniques.

qui incite le périoste à produire de l'os. Citons par exemple les traumatismes et leurs suites, l'irritation mécanique aiguë et chronique, l'hématome du périoste et des parties molles; viennent ensuite la stase veineuse, facteur extrêmement fréquent et essentiellement sélectif; les influences toxiques, les tumeurs situées dans l'os ou ses parages immédiats, ainsi que les complications périostées dans le cours des maladies du sang (infiltration leucémique) et dans les avitaminoses (BARLOW) etc.

Dans les réactions osseuses en relation avec les complexes variqueux, compliqués et non compliqués, nous sommes, dans certains de nos cas, en présence d'un accroissement pathologique de l'os en épaisseur; accroissement dû à la prolifération du périoste. Le périoste »conditionne la croissance en épaisseur». Dans ces mécanismes fort complexes, LERICHE se pose les questions suivantes: Si déjà le périoste conditionne, dans l'os, la croissance en épaisseur, la conditionne-t-il activement? Ou est-il avant tout un lieu passif d'ossification? L. pense qu'il n'est qu'un *lieu* d'ossifica-

Fig. 6. Fig. 7.

Fig. 6. Poro-sclérose diaphysaire du tibia, avec périostose atténuée. Ici le bord adjacent du péroné présente une périostose analogue à celle du tibia, tandis que son bord externe est partiellement porotique, et la périostose lamellaire.

Fig. 7. Tibia: Porose diffuse du segment métaphysaire interne avec amincissement »en lames de ressort» de la corticale. L'arc métaphysaire externe présente une périostose en forme de rail de chemin de fer avec fente basale, nettement visible. Travées horizontales sclérosées dans la portion métaphysaire centrale. Péroné: Ostéophyte du segment sous-capital interne. Périostose linéaire concomitante. Porose capitale. »Pâte feuilletée» caractéristique de la portion médiane de la diaphyse. — *Femme de 53 ans:* Phlébite bilatérale grave il y a 2 ans. De temps en temps, oedème des chevilles. Gros paquets de varices des deux jambes. Pas d'ulcères. (Reins, coeur: sp.).

tion. »Toujours est-il que, secondairement, les lames osseuses primitivement poussées s'érodent, se détruisent, et qu'une ossification intrapériostique nouvelle apparaît suivant le type haversien.»

Dans ce phénomène de la croissance périostique, tout se fait suivant les lois de la formation de la substance osseuse, ou plutôt tout subit l'influence de l'apport calcique, de l'alimentation, de la lumière, de la vitamine D, et sans doute aussi les influences hormonales. *Pathologiquement on retrouve ici, à des échelles variables, les faits qui règlent la vie du tissu osseux.* Du point de vue de la pathologie, la croissance des os est dominée par le problème tissulaire et par le problème hormonal. Elle est prise entre ces deux termes. Il n'y a pas une pathologie du périoste en soi, sauf malformation première. Il n'y a que vie osseuse en perpétuelle évolution. Et il dit encore de la densification osseuse en tant que processus normal et pathologique: »Il y a d'ailleurs bien d'autres faits mystérieux

Fig. 8 a.

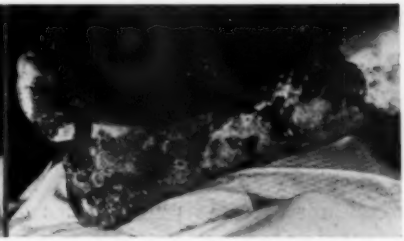


Fig. 9 a.

Fig. 8 b.

Fig. 9 b.

Fig. 8. Se rapporte à l'observation no. 3 du deuxième groupe: a) altération cutanée; b) modifications osseuses.

Fig. 9. Exemple d'une ossification »en toile d'araignée» du ligament interosseux: a) ulcère de la jambe; b) radiographie du membre.

dans les problèmes de la vie du tissu osseux et de l'ostéogénèse. C'est ainsi que nous ne savons pas comment se font les densifications normales, comme celles de la compacte des os longs. Quand nous disons que ce sont des actions mécaniques qui les font apparaître, nous n'exprimons pas, par cela même, la façon dont le tissu s'y prend pour se densifier. De même,

nous ignorons le mécanisme des densifications osseuses pathologiques comme celles que l'on observe parfois localisées à un os, ou à un segment osseux, et qui récidivent même après ablation, sans que l'on puisse saisir l'existence d'un état infectieux ou humoral quelconque. *J'en ai vu au tibia autrefois, sans savoir ce à quoi j'avais affaire.*»[1]

LERICHE aurait-il été en présence d'une réaction osseuse du groupe variqueux? Toutefois il est extrêmement pessimiste quant à nos moyens d'expliquer certains phénomènes de densification osseuse. Et lui qui a vu tant de choses en matière de physiopathologie de l'os, termine par les remarques suivantes:

»J'ai vu des densifications du frontal au niveau de la paroi des sinus frontaux arrivant à supprimer complètement la cavité et provoquant de vives douleurs, avec oedème intermittent du front. Je ne dirai pas qu'il s'agissait d'une réaction autour d'un foyer sinusien latent. Il va de soi que ceci fut cherché par tous les moyens habituels et par les gens les plus qualifiés, mais vainement. Au reste, ne connaissons-nous pas les ostéomes des sinus, maladie de même famille et d'origine inconnue, dont nous ignorons tout? Et l'hyperostose orbitaire interne de Morgagni, qui est, peut-être, ce que j'ai observé? A l'heure actuelle on tend à rattacher ces éburnations localisées du crâne à des méningiomes plus ou moins latents. Mais cela ne résoud pas tout le problème. Il s'en faut. Ne savons-nous pas que certains cals de fracture, et notamment certains cals vicieux, sont faits d'os éburné? Pourquoi? Le problème de la genèse des ostéomes sinusiens me paraît le plus obscur de tous les problèmes de la pathologie osseuse. Comment se font ces masses d'os éburné qui représentent, parfois, un volume énorme de substance osseuse? Je n'en ai aucune idée. Et voici que GEO BELTRAMI nous montre que, chez les animaux en captivité, par conséquent mis à une alimentation médiocre pour eux et certainement toujours carencée, il se fait de volumineux ostéophytes sans raréfaction de voisinage. Chez les lions, il a trouvé de véritables massifs madréporiques greffés sur des os nullement déminéralisés. Le mécanisme de ces lésions nous demeure inconnu. Ne nous refusons pas à l'examiner. Et surtout, ne rétrécissons pas les problèmes de la vie tissulaire à la mesure de nos idées. La vie est bien plus vaste que nous l'imaginons.»

Revenons à nos considérations sur les mécanismes de la prolifération pathologique du périoste.

Manifestations de la périostose. — La périostose se manifeste sous deux formes: l'une localisée, l'autre généralisée. Dans la première, il s'agit d'une irritation d'origine multiple, mais *in loco;* dans la seconde nous sommes en présence d'un processus généralisé, très souvent systématisé.

[1] C'est nous qui soulignons.

Si la périostose localisée se manifeste par des appositions de petit calibre, on appelle pareil processus: ostéophytose. S'il s'agit de manifestations plus importantes, on parle d'exostose. Le tout, en cas d'origine inflammatoire, se nomme périostite ossifiante. Cette terminologie manque de clarté.

Dans certaines leucémies, mais avant tout dans la syphilis congénitale (chez l'enfant), et dans l'ostéopathie hypertrophiante toxique, la périostose peut se manifester de façon généralisée. La plupart des os longs présentent alors des »manchettes» par appositions opaques caractérisées par leur délimitation métaphysaire; les exceptions sont rares. La manifestation systématisée de la périostose se fait par excellence dans la maladie des tourneurs sur nacre. C'est la main qui est généralement atteinte; elle gonfle et devient douloureuse; les métacarpiens médians sont les premiers pris. Ceux-ci présentent alors une périostite »en manchette» le long des diaphyses. Ce processus inflammatoire initial est suivi, après quelques mois, d'une très forte ostéosclérose du tissu spongieux et de la corticale. La mâchoire inférieure peut également être atteinte; mais la maladie a une prédilection pour les os longs. L'étiologie de cette périostite ossifiante n'est pas clairement établie; d'après SCHINZ, l'agent responsable serait un micro-organisme qui pénètre par les plaies de la peau ou à travers une dent gâtée.

Dans les maladies de la moëlle osseuse (leucémies) nous observons, sur les os longs, une périostose chez les jeunes, et une ostéosclérose sans altération de forme chez les sujets âgés. Ainsi, l'os peut réagir différemment à une même cause, suivant l'âge.

Dans l'ostéopathie hypertrophiante toxique, l'épaississement porte sur les os longs. La diaphyse présente une manchette de périostose parfois impressionnante; celle-ci s'amincit au fur et à mesure qu'elle se rapproche de l'épiphyse. La coupe osseuse, sur la préparation anatomique, est très rugueuse; elle ressemble à une écorce de sapin. Ces modifications et appositions ne sont pas l'origine d'une cause irritante d'ordre mécanique. Les os longs distants sont les plus fréquemment pris; leur modification est presque régulièrement symétrique. C'est de nouveau le périoste qui réagit le premier. A la phase initiale, il s'agit d'une infiltration lymphocytaire, cause de l'épaississement de la membrane. Le périoste commence alors à proliférer, et, dans cette masse, l'on assiste à un processus de transformation très curieux. Dans les interstices laissés libres par les vaisseaux, dirigés verticalement vers la corticale, naissent des trabécules osseux en »dents de peigne»; ces trabécules se réunissent à la surface, en arcades. Au fur et à mesure que de nouveaux *stimuli* interviennent, plusieurs couches de rangées trabéculaires se superposent à la manière d'une formation géologique.

Sous l'impulsion continue du désordre central, le processus passe à

la chronicité et subit la loi des réactions individuelles. En cas d'arrêt du désordre central (intervention, thérapeutique efficace), les appositions périostées peuvent régresser entièrement; elles peuvent également être »redressées» en une nouvelle compacte, après avoir passé par un stade lamellaire intermédiaire. L'ancienne corticale, elle, subit une transformation concomitante; sa masse devient porotique en direction centripète; elle prend finalement l'aspect d'un os spongieux. Nous assistons, là, à un de ces mécanismes de transformation osseuse dont LERICHE a toujours souligné les lois mystérieuses. Ainsi la périostose (hyperostose périostée) se transforme sous nos yeux en une hypertrophie osseuse véritable, et la cavité médullaire, en s'élargissant, s'adapte aux nouvelles conditions architecturales.

L'expression radiographique de ces processus a été maintes fois décrite. Nous constatons sur le film ces images »en pâte feuilletée», collées sur la diaphyse. Vers les métaphyses et les épiphyses, l'aspect radiologique ressemble aux lames successivement raccourcies d'un ressort métallique de suspension de carrosserie automobile par exemple. La »pâte feuilletée» présente, là où elle touche l'ancienne compacte, une fente particulièrement visible dans les processus encore récents. Cette fente se dessine plus ou moins nettement sur la radiographie, selon la quantité et la qualité des ponts osseux qu'elle abrite. Nous en avons déjà parlé, lors des mécanismes ossifiants de la périostite au début. Plus le processus est vieux, moins la »fente basale» est visible. Celle-ci, dans certaines conditions, peut même servir à apprécier le degré d'évolution du processus osseux. Au cours des événements, elle peut disparaître noyée dans la masse, pour réapparaître dès que la corticale originaire commence à subir une atrophie concentrique. Elle peut alors atteindre une largeur considérable.

La prolifération du périoste, son ossification et finalement toute la gamme des processus, successifs et surajoutés, sont dues à des causes qu'on ne sait définir, analyser et classer de façon critique. Cependant si l'on admet dans la diversité des causes fondamentales une action toxique, on est probablement dans le vrai. La nature inflammatoire de la périostite semble indiscutable. Mais d'où viennent les éléments toxiques? Les lobules du foie seraient-ils susceptibles, sous l'effet de la stase et de l'anoxémie, de se nécroser ou de manquer à leur fonction anti-toxique? Les éléments nocifs ainsi jetés dans le torrent sanguin, seraient-ils la cause de l'irritation qui engendre la prolifération de la membrane périostée? Peut-être d'autres mécanismes en rapport avec la régulation ostéogène sont-ils en jeu? Rappelons enfin que le manque d'oxygène, ou du moins que des stimuli issus d'une anoxémie, pourraient entrer en ligne de compte (SCHINZ): chez certains animaux, l'on constate normalement une pachyostose des côtes et des vertèbres au moment de leur passage du milieu terrestre au milieu aquatique.

Morphologie radiologique des altérations osseuses en présence d'ulcères variqueux et non-variqueux

(Observations personnelles)

Envisageons d'abord les signes radio-morphologiques des os de malades atteints d'ulcères variqueux plus ou moins étendus et de chronicité différente, en distinguant dans un premier groupe les moins de 60 ans, et dans un second groupe les plus de 60 ans. Le second groupe est le plus important. (Nous parlerous ensuite d'un troisième groupe, ne se rapportant pas, celui-là, aux ulcéres variqueux.)

Premier groupe

1) *Homme de 26 ans.*

Données cliniques: En juillet 1947, apparition d'un ulcère de la jambe gauche. Cet ulcère date d'une année; il s'ouvre et se ferme alternativement. Dimension d'à peine «deux francs» en avril 1947; peu de *varices*. Le patient dit avoir souffert d'une *phlébite* après son école de recrues en 1941.

Traitement: oléate d'argent.

Constatations radiologiques: Ostéophyte spongieux de la partie diaphysaire supérieure du péroné. Ostéoporose de la corticale (type vermoulu) au même niveau. Périostose (type coton) avec amincissement de la corticale dans toute la partie médiane antérieure de la diaphyse, et périostose avec épaississement cortical dans le segment diaphysaire para-métaphysaire interne du tibia. Travées transversales sclérosées au même endroit.

2) *Femme de 42 ans.*

Données cliniques: Souffre depuis l'âge de 18 ans de varices; à l'âge de 26 ans premier *ulcus cruris* de la jambe gauche. En 1942, plusieurs ulcères de la jambe gauche: greffes libres. En 1946, l'ulcère s'ouvre à nouveau.

Traitement: oléate d'argent depuis 1 mois.

Constatations radiologiques: Jambe gauche: Périostose extrèmement fine, visible avant tout dans la partie interne médio-inférieure de la diaphyse tibiale. Ostéoporose marquée de la malléole interne. Ostéoporose de la tête et de la malléole péronières. Porose des os du tarse. La jambe non atteinte présente une légère ostéoporose de la tête péronière avec amincissement de la corticale.

3) *Femme de 40 ans.*

Données cliniques: Prétend avoir des ulcères de la jambe depuis 6 mois (?)

Traitement: repos au lit, compresses d'oléate d'argent renouvelées environ toutes les 3 heures, jour et nuit; plots aux pieds du lit.

Constatations radiologiques: Périostose éburnisante classique (type neige glacée) des deux tibias. Les deux péronés présentent une courbure dorsale et une périostose ondulée, envahissant, par l'épaississement de la corticale, le canal médullaire. Porosclérose des os du pied!

Deuxième groupe

1) Homme de 66 ans.

Données cliniques: Depuis 1933 ulcères récidivants et multiples des jambes. Status variqueux bilatéral prononcé.

Traitement: nitrate d'argent et oléate d'argent.

Constatations radiologiques: Jambe gauche: Bosse de périostose latéro-externe avec périostose diaphysaire moyenne, légère boursouflure porotique du péroné, en fuseau.

Jambe droite: Périostose médiocre de la diaphyse tibiale. Boursouflure porotique du péroné. Les deux tibias présentent des travées horizontales marquées.

2) Femme de 72 ans.

Données cliniques: Depuis un an dans le service, toujours alitée; a souffert de varices depuis l'âge de 24 ans. Fracture jambe gauche à 26 ans. Ulcères des jambes depuis 1941.

Status variqueux aux deux jambes; le pourtour des ulcères est scléreux. État général déficient sans cause décelable.[1]

Traitements: aucun résultat.

Constatations radiologiques: Jambe droite: Ostéoporose généralisée des deux os; sclérose canaliculaire verticale marquée; amincissement de la corticale tibiale et fémorale. Périostose en bande mince du type rugueux, cotonneux et feuilleté; ce dernier spécialement dans le domaine du péroné. Lame fondamentale nettement visible. Sclérose du canal artériel supérieur du péroné. Ossification du ligament malléolaire interosseux. Ostéosclérose de la diaphyse tibiale. Calcification linéaire débutante des parties molles voisines de l'os. *Jambe gauche:* Mêmes modifications, mais plus prononcées. Anciennes fractures consolidées. Ossification et calfification dans les parties molles. Phlébolithe sous-poplité.

3) Femme de 73 ans.

Données cliniques: Ulcères variqueux dès 1922. A son entrée, le 17. 7. 47 (5e séjour à la Clinique dermatologique)[2] elle avait un ulcère étendu de la jambe gauche.

Traitement: au nitrate d'argent et à l'oléate d'argent.

Constatations radiologiques: Entre la prise du premier et du second cliché (radiographies de face) de la jambe gauche, il y a un intervalle d'un an. Il est donc intéressant de constater la modification du processus osseux, pendant ce laps de temps.

Premier cliché: Déformation peu accusée des deux os, par boursouflure. *Second cliché:* cette déformation est très prononcée. Le tibia, comme dans le Paget, est dilaté en forme de bouteille. Le péroné présente un aspect fusiforme accusé. L'ostéoporose, alternant avec des agglomérations sclérosées, est très nette. La corticale a un aspect spongieux; elle est extrêmement amincie. Les parties porotiques méta-épiphysaires inférieures, visibles sur le premier cliché, sont extrêmement sclérosées sur le second; là encore il y a atrophie du cartilage tibio-tarsien et synostose tibio-péronière inférieure. La radiographie de la jambe non atteinte révèle une ostéoporose et un amincissement de la corticale des deux os, et une déformation du péroné en valgus.

4) Homme de 79 ans.

Données cliniques: Réformé du service militaire à 20 ans pour varices. En 1923, séjour en chirurgie pour ectomie d'un noeud variqueux; après quoi apparaît un ulcère

[1] Cas de la Clinique thérapeutique (Professeur Bickel).

[2] Service du Professeur Jadassohn.

de la jambe. Sympathectomie péri-fémorale gauche en 1945, qui ne guérit pas l'ulcère; celui-ci persiste fin 1947.

Traitement: oléate d'argent depuis 15 jours.

Constatations radiologiques: Jambe gauche: Bel exemple de poroscléro-périostose du type lamello-spiculaire avec déformation de la tige péronière. Ossification ligamentaire supérieure et inférieure en toile d'araignée. Périostose (type neige-fondante) du tibia. Petite perte de substance diaphysaire centrale antérieure. *Jambe droite* (non atteinte): périostose-«type» de la diaphyse médiane du tibia. Périostose discrète du péroné. Ossification linéaire centrale du ligament interosseux. Porose de la tête péronière.

5) Femme de 84 ans.

Données cliniques: Souffre d'ulcére des jambes depuis une dizaine d'années. Il y a 8 ans, périphlébite de la jambe droite; depuis lors, ulcères et ecthyma des 2 jambes; celles-ci guérissent et se rouvrent alternativement. Pas de varices, mais oedème des jambes avec pigmentation.

Traitement: oléate d'argent.

Constatations radiologiques: Les 2 tibias présentent une ostéoporose diffuse des segments métaphysaires et une ostéosclérose des diaphyses médianes. La corticale n'est pas spécialement épaissie. Périostose lamellaire et rugueuse du péroné droit. Le péroné gauche présente, à côté d'une périostose discrète, un amincissement considérable de la corticale malléolaire. Ébauche d'ossification du ligament intermétaphysaire des deux côtés. Phlébolithes multiples.

Avant de discuter ces altérations osseuses, leurs origines et leurs corrélations avec l'altération de la peau et avec l'affection de fond, nous voudrions ajouter un troisième groupe à la documentation, en confrontant les modifications osseuses avec des affections cutanées autres que celles qu'on rencontre dans le complexe variqueux. Il s'agit: d'un ulcère tuberculeux, des suites d'une brûlure du troisième degré, de grands ulcères phagédéniques, et enfin d'un petit *ulcus cruris* accompagné d'acrocyanose des orteils des deux pieds:

Troisième groupe

1) Femme de 48 ans.

Données cliniques: La malade, qui présente depuis 1943 des infiltrats et des ulcères *tuberculeux* de la peau spécialement localisés aux jambes, des adénopathies tuberculeuses du cou, s'améliore très remarquablement par le traitement de Charpy. Mais, après 3 mois d'interruption, forte aggravation. La reprise du traitement de Charpy n'empêche pas une péjoration rapide.

Histologie: structure tuberculeuse pas très prononcée. Inoculation au cobaye positive. Une très grande amélioration des ulcérations est obtenue par des cures de pénicilline à hautes doses. L'amélioration continue après un traitement au Rubrophène *per os.*

Constatations radiologiques: Les deux os de la jambe présentent une poro-sclérose. Peu de réaction périostée. La corticale est mince. Dans le condyle interne de la tête tibiale droite, foyer d'ostéosclérose important (tbc. osseuse?).

2) Homme de 32 ans.

Données cliniques: Traité depuis février 1947 pour brûlures étendues du 3e degré, au niveau de la jambe et du poignet droits, provoquées par de la benzine enflammée.

Traitement: oléate d'argent et greffes libres. Au début, épithélisation rapide, puis arrêt presque complet, ce qui oblige à faire des greffes libres.

Constatations radiologiques: Epaississement «en tôle ondulée» de la corticale sous-pariétale du segment diaphysaire médian du tibia, en forme de manchette de 1 ½ cm. de hauteur. Porose nodulaire diffuse de la partie métaphysaire supérieure du tibia, de la tête et de l'épi-métaphyse du péroné. Zones de raréfaction alternant avec de la périostose dans la diaphyse supérieure du tibia et du péroné.

3) Homme de 63 ans.

Données cliniques: Grands ulcères phagédéniques des deux jambes et de la partie distale de la cuisse ayant débuté au mois de juillet 1947. Le malade souffrait précédemment d'ulcères de jambe qui se fermaient et se rouvraient alternativement. Amélioration rapide grâce au nitrate d'argent et à l'oléate d'argent. La jambe droite présentait encore une ulcération encore plus considérable que la jambe gauche.

Constatations radiologiques: jambe droite: déformation fusiforme des segments diaphysaires du tibia et du péroné. Périostose massive en manchette (type cotonneux et lamellaire) des deux os. Calcifications réticulaires des parties molles. *Jambe gauche:* périostose (type neige fondante) avec lamelles ostéophytaires des deux os. Sclérose nodulaire de la métaphyse.

4) Homme de 63 ans.

Données cliniques: Le malade souffre d'un petit *ulcus cruris* du membre inférieur droit et d'acrocyanose des orteils des deux pieds. Nous faisons faire une artériographie de la jambe droite et nous découvrons un Paget avec calcifications des artères.

Constatations radiologiques: les lésions osseuses plaident pour un Paget classique des os de la jambe et du fémur. Nous renonçons à une description détaillée.

En comparant la radiomorphologie des trois groupes, l'on est frappé de ce que, dans le syndrome variqueux (groupes 1 et 2) l'importance de la lésion osseuse est généralement proportionnelle à l'étendue de la lésion cutanée. Tandis que dans le groupe 3, la réponse osseuse est minime par rapport à l'étendue et à la gravité, pourtant accusées, de l'altération de la peau. Dans le Paget, l'ulcère n'était probablement pas dépendant de la maladie osseuse proprement dite, mais dû à une nutrition locale insuffisante.

Dans le groupe variqueux, où est la réaction primitive?

Nous avons déjà insisté sur le fait que si nous sommes en présence d'un *ulcus cruris*, issu de complications veineuses, nous trouvons dans les os, naturellement selon l'importance et la gravité des troubles vasculaires, des modifications plus ou moins accusées du côté de la jambe exempte de manifestations ulcéreuses: ceci nous incite à penser que, malgré l'absence d'ulcération, l'état trophique du membre est déjà déficient. Nous

ne pouvons pas dire quelle est la portion des parties molles qui souffre la première de ce désordre (tissu adipeux, muscles, tendons, peau, etc.?) mais nous pouvons affirmer que l'os est un des premiers à montrer radiographiquement une altération.

Cette première manifestation consiste en une ostéoporose; c'est dans la tête, ou dans la malléole péronière que celle-ci se voit le mieux à cette phase initiale. On est frappé de voir cette réaction se localiser justement dans l'os le plus éloigné de la lésion cutanée, et de celle à venir, et qui est généralement plaquée contre le tibia à un endroit où la proximité peau—os est la plus grande.

Nous ne pouvons pas insister sur les effets des troubles de la circulation veineuse sur les tissus de la jambe, et en particulier sur l'os. Nous nous en tiendrons ici aux constatations radiomorphologiques.

Pourquoi le péroné présente-t-il la première atteinte? Probablement parce qu'en raison de son faible volume, il offre les meilleures conditions de visibilité: les superpositions de la trame trabéculaire n'entrant pas en ligne de compte, les moindres modifications de caractère porotique se manifestent. Au tibia, le volume de l'os et l'épaisseur de la compacte normale masquent le signe en question. Quant à la localisation aux épiphyses, elle s'explique par la forte vascularisation à ce niveau. Nous retrouvons cela dans le »Sudeck», quoique l'étiologie soit différente. Qu'il s'agisse d'hyperémie ou de stase, l'effet est probablement le même.

La seconde phase est celle qui se joue dans le périoste. C'est peut-être à ce moment que des phénomènes analogues, jusque-là radio-imperceptibles, commencent à se signaler sous forme de prolifération périostée dans le tibia.

Nous manquons d'expérience pour juger l'évolution de telles modifications tissulaires et de leurs manifestations radio-morphologiques. Nous avons vu, parmi nos confrontations cliniques et radiologiques, des périostoses qui ressemblent à des ostéophytes spongieux, à des périostoses plus diffuses (type coton) qui doivent probablement leur aspect à la prolifération prépondérante de spicules. Nous avons vu le type »pâte feuilletée», le type de la »neige fondante» et enfin le type de »l'éburnisation homogène».

On peut également se trouver en présence, comme nous l'avons vu dans un cas très démonstratif, de processus porotiques de longue haleine avec amincissement impressionnant de la corticale et sclérose linéaire du périoste. Ces processus peuvent subir, selon le caractère évolutif des ulcérations et sous l'effet de facteurs surajoutés (diabète, infections bactériennes) des remaniements de sclérose trabéculaire importante, accompagnée d'atrophie cartilagineuse et d'ankylose des articulations. Dans certaines périostoses éburnisantes du tibia et du péroné, nous avons

pu constater des poroses des os du tarse et du métatarse que nous ne jugions pas en rapport avec une atrophie sénile.

Tous ces mécanismes sont donc fort complexes; nous pouvons rencontrer simultanément, *sur un* territoire osseux, une périostose massive, *et sur un autre* un processus porotique.

Ceci nous conduit à considérer l'effet éventuel qu'aurait la lésion cutanée sur l'os. Des auteurs, et parmi eux JAEGER (Lausanne), pensent qu'un ulcère chronique dessine et délimite, sur l'os sous-jacent, une réaction périostée de dimensions correspondantes. Nous avons observé des faits analogues. Mais nous estimons que, dans ces cas, nous sommes en présence d'un élément surajouté au cours des complications du syndrome variqueux.

Il est certain qu'un *ulcus cruris* peut être capable d'altérer l'os sous-jacent, surtout lorsqu'il s'agit de la région du bord tibial médian antérieur. Ici les hypothèses citées plus haut ont du poids. Ce »stade du moule cutanéo-osseux» peut être de plus ou moins longue durée, selon les conditions locales et générales qui entrent en jeu. L'infection de la peau y joue certainement un rôle important. Mais les relations peuvent se rompre dans le cours d'une année.

Cet »effet de sceau» n'est pourtant pas constant. Nous avons vu, dans les syndromes variqueux: d'une part, une petite lésion cutanée avec grande altération osseuse concomitante, et d'autre part, une grande lésion cutanée avec réaction osseuse de petites dimensions. Par ailleurs, nous avons déjà insisté sur la faible influence qu'exercent, sur l'os correspondant, des lésions cutanées graves et étendues de la peau lorsqu'elles sont de nature tuberculeuse ou tuberculoïde. Quoi qu'il en soit, nous pensons qu'il y a peut-être, dans les complications veineuses, des mécanismes qui règlent le rapport d'intensité et de surface entre la lésion cutanée et la lésion osseuse (mécanismes qui ne sont pas nécessairement dictés par l'une ou l'autre partie). En présence du »symptôme de la démarcation bilatérale», nous admettons des processus irritatifs supplémentaires déclenchant ou activant, soit dans l'os, soit dans la peau. Et ceux-ci ne sont pas toujours d'ordre local. Il est alors possible que l'irritation supplémentaire puisse partir de l'os et que la lésion cutanée n'en soit pas toujours le point de départ comme on l'a admis jusqu'ici. Rappelons l'exemple du panaris, où, très souvent, des destructions tissulaires emportant même une partie du tendon, n'arrivent à modifier ni l'aspect anatomique ni l'aspect radiologique d'une phalange. Si déjà nous attribuons à l'ulcère un rôle primordial dans l'altération osseuse sous-jacente, il faut du moins admettre que l'os soit d'une part *préparé* localement à subir l'influence de la lésion cutanée, et d'autre part, que sa réaction spéciale soit liée à une prédisposition.

Dans les cas qui se distinguent par une ostéoporose chronique ac-

compagnée d'ostéosclérose (secondaire ou concomitante), la tendance à l'ossification du ligament interosseux est plus prononcée; cette ossification peut être centrifuge ou centripète. Dans le premier cas, nous voyons apparaître une densification en fine bande, verticale, du centre ligamentaire, à la hauteur des diaphyses, densification qui ressemble à une goutte de paraffine étirée.

Dans le second cas, une prolifération semble partir simultanément du périoste du tibia et du péroné formant des »toiles d'araignée» dans les recoins proximaux et distants des épiphyses, opacités constituées par de l'os devenu spongieux.

Notons en dernier lieu, les densifications des parties molles. JÖRIMANN fait mention de densifications nuageuses et agglomérées, probablement dans les muscles, dans les cas d'ulcères, et de lésions osseuses d'origine traumatique. Ces cas semblent poser un problème différent. Cependant, comme on vient de le voir dans nos cas d'ulcères variqueux, nous avons constaté, dans les parties molles et dans les veines, des calcifications probablement dues à des mutations calciques; car elles sont presque toujours combinées à des états de porose et de décalcification des os. Notons encore, à côté des phlébolithes, l'athéromatose artérielle qui, dans la vieillesse, peut être partie du syndrome variqueux, et peut-être responsable de certaines influences dans les altérations cutanéo-osseuses des jambes.

Ainsi l'étude approfondie des réactions osseuses et cutanées, et celles du milieu ambiant (muscles, vaisseaux, etc.), dans le syndrome variqueux, postule des investigations très complexes: recherches sur la température de la peau, sur les éléments vaso-moteurs, sur le métabolisme basal, sur la calcémie, la phosphatasémie, etc., sur l'examen fonctionnel de la circulation (phlébographies et artériographies comprises); l'examen des fonctions intestinale et rénale, recherches endocrinologiques),[1] examen radiologique systématique du squelette (et non seulement des os des jambes); étude bactériologique des ulcères; enfin biopsie osseuse et contrôle nécropsique, sur une large échelle, des modifications locales et des répercussions immédiates et lointaines du complexe variqueux.

Réactions précoces des parties molles dans l'ostéomyélite

En guise *d'appendice*, nous voudrions encore citer, à titre d'exemple, les répercussions précoces de certaines affections osseuses sur les parties molles environnantes. Ces effets sont particulièrement visibles dans les premiers stades de l'ostéomyélite.

[1] Nous avons procédé, dans divers cas, à l'exploration radiologique de la selle turcique et avons constaté des calcifications intra- et parasellaires; nous nous gardons d'en tirer des déductions mais il semble qu'en dehors des altérations dues à l'âge, cela vaille d'être souligné.

Nous pouvons déceler sur le cliché, à un moment où la radiographie ne révèle encore aucune modification structurale du tissu osseux, des symptômes déjà pathologiques des parties molles. FERGUSON les a mentionnés le premier dans sa monographie sur les maladies osseuses; nous-mêmes les avons constatés à maintes reprises, surtout chez les enfants; BAŸLIN et GLENN, qui les ont étudiés, en ont recherché l'étiologie et les fondements physio-pathologiques.

Généralement une ostéomyélite aiguë ne donne pas de signes à la radiographie. (En certains cas, les premières modifications osseuses macroscopiques peuvent apparaître aux environs du deuxième jour. Mais nous avons observé des lésions importantes qui, n'ayant donné aucun signe radiologique pendant deux mois, apparurent tout à coup sous forme de foyers ostéolytiques importants.)

Il faut savoir cependant que des modifications des parties molles peuvent donner des signes radio-perceptibles parfois 24 heures après l'apparition des premiers symptômes cliniques. Pour les dépister, il faut recourir à un rayonnement très mou. Nous recommandons, dans tous les cas d'ostéomyélite aiguë, de faire une radiographie osseuse d'orientation avec les données techniques habituelles, puis une deuxième radiographie exclusivement destinée à la recherche de nuances dans les parties molles. Que peut-on constater?

Voici ce que disent BAŸLIN et GLENN:

»Le principal changement dans l'ostéomyélite précoce est un changement de la ligne de démarcation entre l'ombre sous-cutanée et le faisceau musculaire; d'habitude nette, elle devient plus rugueuse. Une autre anomalie concomitante est la tendance à l'oblitération des plans de clivage intermusculaires: chez le sujet normal, la ligne musculo—sous-cutanée donne un contraste net; dans l'ostéomyélite aiguë l'on voit une déformation de cette ligne, caractérisée par des stries irrégulières transversales, de densité augmentée; celles-ci vont de la bordure musculaire aux ombres sous-cutanées; elles semblent produire un dessin croisé qui pourrait faire penser à des canaux lymphatiques ou vasculaires dilatés.«

Ces changements varient d'intensité aux divers stades de la maladie. Ils peuvent être observés radiologiquement même en l'absence de toute tuméfaction apparente. Ces transformations des parties molles intéressent tous les tissus le long de l'os atteint. Si l'extrémité supérieure, ou une autre partie du fémur, est siège de l'altération, les parties molles, tout le long de l'os, sur les faces latérales, médianes, antérieures et postérieures, accusent des transformations; elles ne dépassent pas l'articulation, à moins que celle-ci ne soit atteinte. S'il y a réaction périostée, avec rupture de la corticale, les altérations des parties molles ont une certaine tendance à régresser, mais elles peuvent persister longtemps. Pour être

à l'abri d'une erreur d'interprétation, il faut radiographier le côté normal correspondant dans les mêmes conditions techniques.

L'origine des modifications des parties molles est probablement due à l'augmentation de tension dans la cavité médullaire à la suite de l'infection. Cette augmentation de pression est transmise à travers un espace clos aux systèmes haversiens et de là aux tissus environnants. Il en résulte un effet mécanique sur les systèmes lymphatiques et vasculaires, effet qui conduit à une dilatation des vaisseaux et à l'ouverture de canaux jusque-là purement virtuels. En plus, il y a l'oedème des muscles et du stroma environnants. Ces deux facteurs jouent probablement un rôle dans la morphologie radiologique. On pourrait encore penser que les produits toxiques issus de l'infection sont capables d'altérer les tissus mous.

Citons encore les travaux de HADRI. Cet auteur a démontré l'augmentation de pression intra-osseuse dans l'ostéomyélite. Voyant très souvent des lipuries dans les affections osseuses aiguës, il conclut qu'à un certain degré de tension, la graisse de la moëlle est poussée dans les veines et passe dans les urines: sa recherche est un précieux moyen de diagnostic précoce dans l'ostéomyélite aiguë. Dès que l'infection passe de la cavité médullaire dans l'espace périosté, l'hypertension intra-osseuse et la lipurie disparaissent; parallèlement les modifications radiologiques des tissus s'effacent. FERGUSON pense que le siège primitif des altérations est à l'intérieur de l'os, et que ce foyer déclenche très vite une inflammation des éléments de la cavité médullaire; inflammation qui a pour conséquence une oblitération locale des trabécules; sur le film, à ce moment, le dessin osseux devient flou et s'efface.

Conclusions

Dans le *complexe variqueux*, les premiers symptômes bio-cliniques se manifestent dans les os de la jambe avant qu'on puisse voir une modification des téguments. La radiographie montre: *ostéoporose* de la tête, ou de la malléole du *péroné*, ou des deux à la fois. Sur cette ostéoporose se développe, avec le temps, une ostéosclérose et une prolifération du périoste. Dès ce moment, le tibia présente à son tour des symptômes radiologiques: le processus est avant tout localisé au périoste de la portion diaphysaire. Contrairement à LIECHTI et JÖRIMANN, nous n'avons pas constaté de prédilection de la périostose pour la métaphyse. La phase ostéoporotique du tibia est difficile à saisir à cause du volume de l'os! Il est aussi possible que les conditions locales du mécanisme régulateur neurovasculaire diffèrent pour les deux os. Le processus au niveau du périoste tibial est très démonstratif: en cas d'absence d'altération cutanée, la périostose constatée a été principalement du type »pâte feuilletée». En pré-

sence d'un ulcère, elle a été, dans la majorité des cas, du »type cotonneux« ou »en neige fondante«. Plus l'ulcère est chronique, plus il gagne en profondeur et en largeur, plus le caractère de la périostose devient éburnisant. *Dans certains cas, nous avons constaté le symptome du »moule cutané-osseux«* (»effet de sceau«), *mais il s'en faut de beaucoup qu'il soit constant.*

Certains ulcères variqueux sont accompagnés d'un processus osseux où la poro-sclérose de la corticale et de la spongieuse domine, et où la périostose est réduite à son strict minimum. Dans ces cas, les ponts interosseux (ossification du ligament interosseux) sont les plus fréquents. Là encore, il y a non seulement transformation de la structure, mais également déformation de l'os. Sommes-nous alors en présence de la phase terminale du remaniement osseux?

A notre avis, l'os peut présenter des modifications avant que n'apparaisse l'ulcère; car, dans le syndrome variqueux sans ulcère, et dans des cas à lésion cutanée unilatérale, nous avons constaté des modifications *du côté de la jambe »saine«*. Le désordre de la circulation veineuse, apparent d'un côté seulement, est donc capable de déclencher, du côté opposé, des troubles de la structure osseuse cliniquement muets. Comment l'expliquer? Ou bien le syndrome variqueux apparement unilatéral est une affection réellement bilatérale, d'emblée ou progressivement; ou alors il suscite des mécanismes sympathiques qui se répercutent sur le membre opposé.

Nous insistons cependant sur l'idée que des altérations dystrophiques peuvent exister dans la peau ou les autres parties molles sans se manifester macroscopiquement; elles pourraient bien coexister avec les altérations de l'os, et même les précéder. Quoi qu'il en soit le phénomène osseux révélé par la radiographie est le premier *signal bio-clinique* des troubles de la circulation veineuse.

Quant à la relation de l'ulcère avec l'altération osseuse, nous nous abstenons de la commenter. Notons cependant que, dans le complexe variqueux, il y a discordance entre l'intensité de la réaction osseuse et celle de la lésion cutanée; cette dernière est de moindre importance dans la majorité des cas.

La même discordance existe pour les ulcères qui n'ont pas pour origine le complexe variqueux, mais en sens inverse: en effet, il est frappant que des ulcères tuberculeux très étendus ne s'accompagnent que de réactions osseuses minimes.

RÉSUMÉ

Dans l'ulcère variqueux, les os de la jambe peuvent présenter des modifications de structure et des réactions périostées avant l'apparition macroscopique des modifications cutanées. Dans le syndrome variqueux sans ulcère, ou aussi dans les cas à lésions cutanées unilatérales, les A. ont constaté radiographiquement des modifications osseuses

du côté de la jambe réputée saine. Ils admettent que le désordre de la circulation veineuse, apparent d'un côté seulement, est capable de déclencher, du côté opposé, des troubles de la structure osseuse qui sont cliniquement muets. Ils formulent l'hypothèse suivante:

Le syndrome variqueux, apparemment unilatéral, serait en fait une affection bilatérale dans laquelle les altérations dystrophiques pourraient exister dans la peau ou les autres parties molles sans se manifester; ces altérations pourraient coexister avec celles de l'os, ou même les précéder. Quoi qu'il en soit, le phénomène osseux révélé par la radiographie est, dans la plupart des cas, le premier signal bio-clinique des troubles de la circulation veineuse.

SUMMARY

In conditions of varicose ulcer changes in the bone structure and periosteal reactions may be seen in the bones of the leg, before cutaneous modifications are macroscopically detectable. The authors have been able to verify on roentgenographic examination that osseous alterations, located to the *unaffected* leg, were present in varicose veins without ulcer, or also in conditions with unilateral cutaneous modifications.

In their opinion, the disorganization of the venous circulation, apparent only on one side, may give rise to changes in the osseous texture on the opposite side which clinically are silent.

From these considerations the following hypothesis is advanced: The varicose syndrome, unilateral in appearance, is in reality a bilateral morbid process, in which dystrophic disturbances may involve the skin and the other soft tissues without being recognizable. These alterations may be associated with osseous changes or even precede them.

At any rate, the pathological osseous features disclosed by the roentgenographs ensure, in the majority of cases, the first bio-clinical sign of disturbances of the venous circulation.

ZUSAMMENFASSUNG

Beim Ulcus varicosum können die Knochen des Beines Veränderungen des Baues und periostale Reaktionen aufweisen, schon ehe makroskopische Hautveränderungen auftreten. Bei Krampfadersyndrom ohne Geschwür sowie bei Fällen mit einseitigen Hautläsionen haben Verff. radiographisch Knochenveränderungen am gesunden Beine festgestellt. Sie geben zu, dass die nur einseitige venöse Kreislaufsstörung auf der Gegenseite klinisch symptomlose Störungen der Knochenstruktur hervorrufen kann. Sie stellen folgende Hypothese auf: Das augenscheinlich einseitige Krampfadersyndrom stellt in Wirklichkeit ein doppelseitiges Leiden dar, bei dem die dystrophischen Veränderungen in der Haut oder den übrigen Weichteilen vorliegen können ohne Symptome zu geben; diese Veränderungen können gleichzeitig mit denjeningen in den Knochen vorhanden sein oder ihnen sogar vorausgehen. Wie dem auch sei, so ist dieses durch die Röntgenaufnahme zu entdeckende Knochensymptom in der Mehrzahl der Fälle das erste bio-klinische Anzeichen der Störung des venösen Kreislaufs.

BIBLIOGRAPHIE

1) Aievoli: Gazz. interna. med.-chirurg. *12*, 154 (1924).
2) Archer: Handbook Roentg.-Diag. Osseous System, Chicago (1945).
3) Babaiantz: Ostéoporose, Cong. Rad. Suisse (1947), Radiologia Clinica (1947).

4) Baylin et Glenn: Am. Jour. Rad. Vol. 58, 2 (1947).
5) Berde: Zbl. Haut-Krht. (1940): cité d'ap. Jörimann.
6) Billroth: Sur l'influence réciproque de cellules végétales et animales vivantes, Vienne (1890).
7) Brailsford: Rad. Bones and Joints, Baltimore (1945).
8) Caffey: Ped. X-Ray Diag., Chicago (1945).
9) Ferguson: Ann. Roentgen. New-York (1941).
10) Frey: Med. Klinik, *31* (1925).
11) Guszman: Zbl. Haut-Krht. (1940): cité d'ap. Jörimann.
12) Jaeger: Cong. de Derm. Genève (1947).
13) Jörimann: Rad. clin. 14, 262 (1945).
14) Kémeri: Zbl. Haut-Krht. (1940): cité d'ap. Jörimann.
15) Klapp: Arch. Klin. Chir. 127, 500 (1923).
16) Leriche: Physiologie et pathologie du tissu osseux. Masson. Paris (1939).
17) Lichtwitz: Presse méd., *48*, 654 (1946).
18) Morris: Surg. Gynec. obst. (1920).
19) Nobl: Le syndrome variqueux. Berlin (1918).
20) Policard: L'appareil de croissance des os longs. Masson, Paris (1941).
21) Rutishauser: Cahiers mens. de Méd., *3*, 4 (1947).
22) Schinz: Traité de Radiologie, Leipzig (1939).
23) Windholz: Radiology *44*, 1 (1945).

FROM THE ROENTGENDIAGNOSTIC DEPARTMENT OF THE UNIVERSITY CLINICS, LUND, SWEDEN (HEAD: PROF. HANS HELLMER)

CYSTOGRAPHY WITH GRADUATED COMPRESSION[1]

by

Olle Olsson

Cystography has been practised clinically since about 1905. This examination method has, however, made but little progress as compared with the roentgen diagnostics of the other parts of the urinary tract. This is of course due mainly to cystoscopy, the most widely used and highly developed form of endoscopy. Another factor dullening the interest in cystography, is, however, also the roentgenological inaccessibility of the bladder.

The bladder is a voluminous hollow organ with a pronounced reservatory function. It can hold large quantities of radiopaque substance. This makes a thick layer of contrast medium necessary under ordinary roentgenexamination conditions. Endeavours have been made to eliminate this inconvenience by using various concentrations of radiopaque substances, by taking various projections of the bladder, and by filling the latter to various degrees.

Also gaseous media have been employed and even recommended in spite of the well-known risk of gas-embolism. Combinations of positive and negative contrast media have also been suggested, in their most elaborate form by KNEISE and SCHOBER in their so-called Abrodilpfütze.

Especially in the diagnostics of tumours of the bladder does cystography constitute a valuable tool. In these cases it is necessary to determine as exactly as possible the size and shape of the tumours outpouching in the bladder lumen. Furthermore, a careful study of the attachment of the tumour to the wall of the bladder and possible mural infiltration is of great import. In cases of this nature it is not infrequent that cystography can divulge clearer evidence than cystoscopy. The diagnostic value of cystography is most perspicuous in cases of tumours with bleedings that render cystoscopy very difficult or even impossible. Also the combination of radiologic and surgical therapy of tumours of the bladder

[1] Submitted for publication, Jan. 20, 1948.

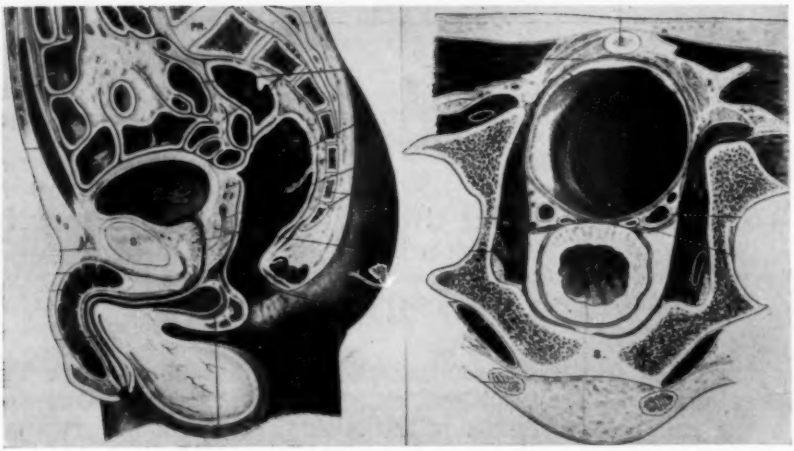


Fig. 1 a. Fig. 1 b.

Fig. 1 a (after BRAUNE): Sagittal section
Fig. 1 b (after PIROGOFF): Horizontal section
} demonstrating the topographical relationship between the bladder and the rectum.

Fig. 2. The distinctor. The left part of the picture shows the distinctor clad in a rubber finger stall.

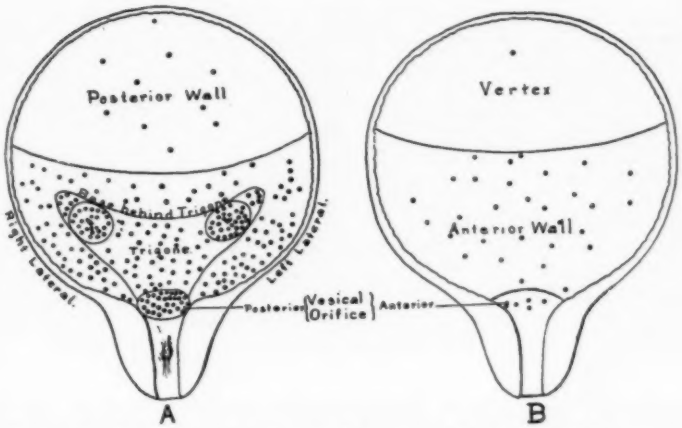


Fig. 3. Chart showing frequency of vesical tumors. Diagram carefully prepared from 209 cases, benign and malignant bladder tumors. Note the infrequency of tumors on the vertex and high posterior wall. The relative infrequency on anterior wall. Great frequency in base, particularly in region of ureteral and prostatic orifices.

requires an exact determination of the size and form of the tumour both in the first examination and in after-examinations. The need of a simple, standardizable examination technique is obvious.

In another hollow organ, the stomach, the position, size and form of a tumour may be ascertained with considerable exactitude. The diagnostics of tumours of the bladder ought preferably to be as similar as possible to that of stomach tumours. A deciding factor in establishing a diagnosis of the stomach is so-called *graduated compression*.

By the application of graduated compression to a hollow organ filled with radiopaque substance the radiologist can select that thickness of the radiopaque layer that produces the most distinct and detailed visualization of the pathological process.

In spite of the fact that the bladder is well embedded, it is nevertheless possible to subject it to compression, namely *per rectum*. Figures 1 a and b illustrate the topographic relationship between the bladder and the rectum. By means of a so-called »distinctor», introduced per

Fig. 4. Papilloma ves. urinar.

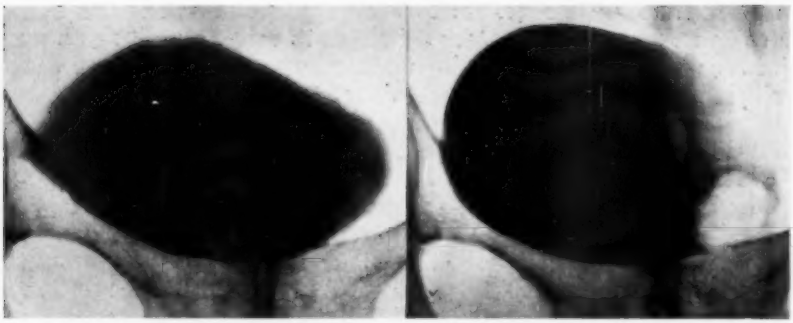


Fig. 5 a. Fig. 5 b.

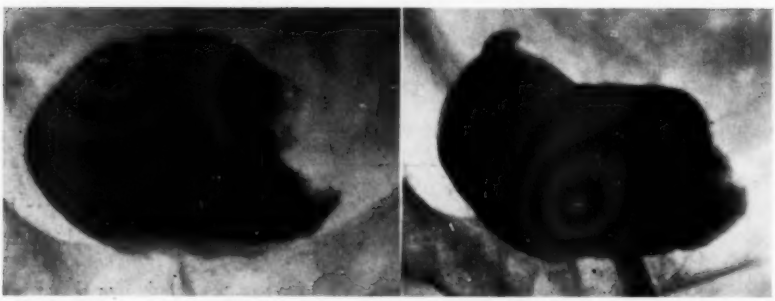


Fig. 6 a. Fig. 6 b.

Fig. 5. Same case as Fig. 4. Seven weeks after preoperative radiologic treatment.
a) without compression per rectum.
b) with compression per rectum.

Fig. 6 a. Cancer ves. urinariae.

Fig. 6 b. Same case two months after preoperative radiologic treatment.

rectum, it is possible during fluoroscopy selectively to compress the bladder filled with radiopaque substance. Defects in the filling may then be studied with varying thickness of the layer of the contrast substance, it also being possible to study the flabbiness of the wall of the bladder and thereby determine the presence or absence of mural infiltration.

The distinctor is made of wood. It has in front the form and size of an ordinary index finger and is provided with a long handle (Fig. 2). A rubber finger stall is drawn over the distinctor and fastened by means of adhesive tape. The distinctor might feasibly be given another shape and be made of other radiolucent material softer than wood.

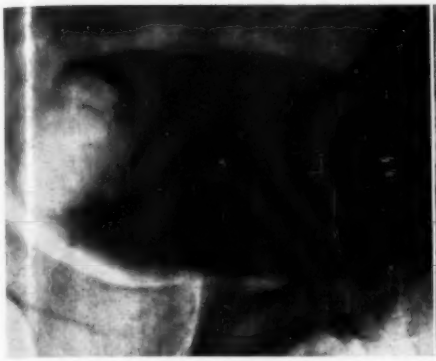


Fig. 7 a.

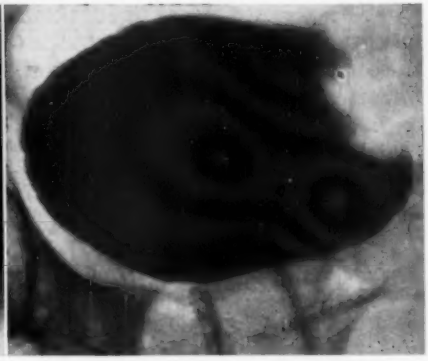


Fig. 7 b.

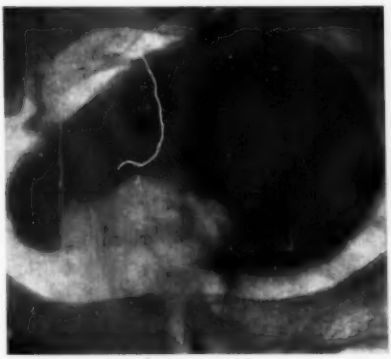


Fig. 8.

Fig. 7 a. Papilloma ves. urinar., attached to the wall of the bladder by a thin stalk.
Fig. 7 b. Papilloma ves. urinar. maligna, with a broad-based attachment to the wall of the bladder.
Fig. 8. Cancer prostatae.

The examination technique is very simple. In the previously evacuated bladder a quantity of radiopaque substance sufficient moderately to fill this organ is instilled, the filling process being controlled by fluoroscopy. The density of the contrast medium may vary, but ought preferably to be relatively high. After the distinctor has been carefully rubbed in with ointment, it is introduced per rectum. During fluoroscopy the patient is turned in various directions and the bladder palpated by means of the distinctor, held and guided by the hand in a protective glove. The bladder is simultaneously compressed from the abdominal side by means of the other hand or a cushion. Radiographs are taken on the basis of the fluoroscopic findings, with accurate primary screening.

The distinctor must be manipulated with utmost caution. Careless palpation causes the patient pain.

The method mentioned permits of an exploration of the bladder, above all of the posterior and inferior parts. Especially these parts are regions for which tumours exhibit a distinct predilection, as will be apparent from Fig. 3. with text by YOUNG and WATERS which is based on an anatomo-pathological investigation.

A small number of pictures will suffice to illustrate the practicability of and the results obtained by this method. Only in one case (Figs. 4 a and b) has a tumour of the bladder visualized both with and without compression been illustrated. The purpose of the illustrations is to demonstrate how informative the examination results obtainable by this very simple examination method really are. The method has indisputably been of a very great value to us in the discovery of bladder tumours, in determining their nature and in evaluating their size.

SUMMARY

Graduated compression, the basis of the roentgen examination of the stomach, is rendered possible in cystography by means of a so-called »distinctor» introduced per rectum.

ZUSAMMENFASSUNG

Dosierte Kompression, die die Basis der Röntgenuntersuchung des Magens darstellt, wird bei der Cystographie mittels eines per rectum eingeführten, sog. »Distinktors» ermöglicht.

RÉSUMÉ

Dans la cystographie aussi, la compression graduée, qui est la base de l'examen radiologique de l'estomac, est rendue possible par le moyen de ce qu'on appelle un »distincteur», introduit dans le rectum.

PHYSICS DEPARTMENT, ROYAL CANCER HOSPITAL (FREE), LONDON, S. W. 3, ENGLAND

THE ORGANISATION OF TEACHING AND RESEARCH IN MEDICAL PHYSICS[1]

by

W. V. Mayneord, D. Sc., F. Inst. P.

Lecture delivered at Karolinska Institutet, Stockholm, on 3rd September 1947

Introduction

May I first say how much I appreciate the invitation to discuss with you some of the problems of education and research in medical physics. It is indeed an honour to find myself in an Institution whose contributions to this and allied subjects are second to none. The influence of Radiumhemmet, its outlook, techniques and methods, is to be found in every part of the world. Radiological education over many years and in many countries owes you an incalculable debt. We in London gratefully acknowledge our own.

Yet sincerely believing that physics has a vital part to play in medicine, I would like to bring before you certain observations about medical physics which have been growing in my mind during the last few years, hoping that discussion may more clearly focus the problems and contribute to their solution.

Medicine and Physics

It is now quite commonplace to note the influence of developments in physics on our lives. We need recall merely the development of electrical science of all kinds, the influence of the new science of electronics in telecommunication, or most spectacular of all, the flash of the atomic bomb casting its deep shadows over the life of humanity. If we confine ourselves to medical science alone, we again see the ever-increasing part physical science is playing. The discovery and development of new physical agents such as extremely high voltage Roentgen rays, artificial radioactive substances, neutrons, and many others, have placed in our

[1] Submitted for publication Dec. 16, 1947.

Ac—480088. *Acta Radiologica. Vol. XXIX.*

hands biological and clinical weapons, frequently two-edged, to be studied, modified, and applied with increasing precision and power.

Though the detail and circumstances be new, such general development is a repetition of previous experiences of mankind. Advances in fundamental science react immediately upon medicine by offering new techniques and procedures, new possibilities of treatment and investigation. A little more remotely such advances sometime call forth new conceptions of the nature of Man and the Universe, and invariably introduce new fashions in explanations. The evolution of physical science is closely paralleled by an adjustment of basic ideas in biology and medicine. Today, it seems, is the day of the atomic nucleus and the newly synthesised organic molecule, perhaps of the introduction of the techniques of nuclear physics into the clinic. The Geiger-Müller counter shyly takes its place beside the stethoscope. Meanwhile our ideas of the structure and mode of action of living things are also undergoing development. We physicists are capturing something of the dynamic conception of life processes which the biologist has held for so long. Radioactive isotopes reveal apparently stable structures as the seat of intense synthesis and destruction. Even physicists begin to believe in biological variation when they see in it a new and fascinating example of generalised statistical theory spiced with a modicum of quantum dynamics. The vagaries of inheritance are carried back to the effectively small number of particles in the hereditary unit with the consequent breakdown of the laws of matter en masse. The mutation and the malignant process are seen as quantum jumps in a supermolecule. So do we physicists and biologists learn each others jargon to our mutual advantage.

Education in Medical Physics

It was hoped that it might be of interest to describe briefly some of the developments in the organisation of education and research in medical physics which have taken place, particularly in England, during the last few years.

We will commence, therefore, with some educational topics, distinguishing between various groups of students, each raising its own problems and requiring its own solutions. We shall be particularly concerned with the education of the qualified medical practitioner wishing to specialise in Medical Radiology, either as a therapist or as a diagnostician, and also with the education in physics of the undergraduate medical student. We must discuss the education of the hospital physicist himself, as well as touch upon the more general questions of teaching physics to undergraduate medical students. Closely correlated must be problems of organisation of fundamental and applied research in medical physics,

for the mutual education and dependence of those working together as a team are matters of the highest importance. We must also discuss the necessary organisation to ensure that so far as possible the individual patient receives the maximum help and benefit from the combined experience of those responsible for him. Such an organisation is, I believe, of importance, for without it the most admirable physical research and wide experience of technical methods can be divorced from clinical practice and largely ineffective in so far as influence on the fate of the patient is concerned. As a physicist I omit, of course, all questions of medical education except in so far as they are dependent upon or influence the teaching of physics, or the use which the medical man can make of the researches and experience of his physical colleagues.

Undergraduate Physics

Immediately on leaving school and entering the medical college, in England, the student takes a preclinical course of chemistry, biology and physics. The course extends over one academic year prior to the commencement of studies in anatomy and physiology, and consists of about two lectures and six hours practical laboratory instruction per week. The course in physics in general is of about the standard required for the first year of a science degree but with a definite medical bias. In certain instances the physics is taught in the normal physics department of the University. Personally, I think, this is not good as the course is apt then to be too closely modelled on that planned for students of pure science. The subject should be taught by those having practical knowledge of medical applications of physics and engaged in some aspect of biophysical or medical-physical research. With the increasing importance of physical methods of investigation throughout medicine this teaching of the undergraduate is fundamental.

Much of what I have to say today will be concerned with the narrower problems of medical radiology but I would try to make it clear that radiophysics, that is physics in medical radiology, is only one particularly striking example of medical physics, a much more important subject. The general training of the medical undergraduate in physics must be of such a character as to enable him to appreciate generally the use of physical methods and to provide a sure basis on which to build should he later decide to devote himself to radiotherapy or some other speciality, such as electrophysiology, where a more detailed knowledge of a particular branch of medical physics is requisite.

It is not easy to design a satisfactory general course of medical physics. Many of the subjects lie on the borderland of physics, colloid physics and chemistry. There must be a discussion of surface energy,

of osmotic pressure, of concentration cells, all of them subjects with which the normal physicist has little acquaintance. They must be discussed à propos of the most complex systems of which we have knowledge. The whole subject is in some ways reminiscent of the doctors' own drugs, »Unfit for children». Yet the attempt must be made and in skilful hands can be at least partially successful.

The teaching of medical physics to undergraduates in London is now in a state of flux. If the University accepts the recommendations of Boards considering the matter the First M. B. Examination will be abolished and the first year course of physics, chemistry and biology integrated with those of anatomy and physiology. These recommendations have arisen partially to shorten the medical curriculum and also to give physiologists and anatomists additional time for their subjects, while, as indicated, the teachers of the first year subjects have been dissatisfied with the content and lack of direct application of the prescribed syllabus to medicine. A particular difficulty has arisen in that it was possible to obtain exemption from the First M. B. Examination in physics on the basis of qualifications which could be obtained at school before entering the medical college. The new scheme which substitutes for study at school a course of study which must be followed after entry to a medical college, would give the necessary freedom and atmosphere for teaching the fundamentals of medical as opposed to pure physics.

The Education of the Radiotherapist in Physics

It is now generally conceded that the radiotherapist at least, must have some special instruction in physics if he is to understand at all fully the techniques he will be called upon to use. Often this is considered as necessary, or should I say 'unfortunately necessary' technical instruction, but little else. It has even been argued that physical instruction should be in the hands of the Professor of Radiology who is best able to judge what is required and most useful, though in view of the more recent developments of physics most Professors of Medical Radiology would, I think, hesitate to undertake this responsibility.

What, then, should be our aims in education in physics for medical men intending to specialise in radiation therapy?

We must obviously beware of trying to make pure physicists. No-one with experience of the practice of radiation therapy would deny that fundamentally the radiotherapist is a clinician with all that that implies. His technical training is definitely secondary to his medical competence. He may, though knowing little physics, by long experience become a competent radiotherapist, but his lack of technical skill and knowledge of recent advances must introduce severe limitations.

Our aim must be to give such instruction as will convey to the student the technical knowledge requisite for a clear understanding of the weapons he is to use; to enable him to realise their nature, powers and limitations. I think that into this process of technical education we must infuse some higher ambition. We must try to convey something of the power of the quantitative method and arguments of physics with their gathering momentum in practical clinical work, in experimental biology, and particularly in such branches of cytology and biophysics as lie closest to the field of radiation therapy. We must make clear something of the beauty and precision of physical science, convey something of the conception of medical radiology as a developing adventure. We shall often fail, but I think from experience that we need not wholly fail. Via a fact which is obviously useful in an examination answer, many a student has been lured to interest in the discovery of facts for himself and to the wider implications of pure science in medicine.

Physics must admittedly be first presented as useful in every-day radiological practice, but eventually as having an appeal as a powerful tool in the development of the radiology of the future. I believe that the physics taught to medical radiologists should comprise more than a rather dreary elementary description of roentgen circuits or the devious ways of a dosemeter. It must present a lively picture of our ideas of the nature of radiations and the technical means to produce, measure and use them, together with a real attempt to analyse and set forth the physical basis of radiotherapeutic technique. It must deal adequately with the physics underlying the chain of events preceding biochemical, and eventually biological, effects of radiation in living tissues.

We have presented the problem of education in Medical Radiology as divisible into various aspects according to the group of student considered, but in reality each student is himself an individual. Some will attain bare competence, some become excellent radiotherapists with little thought for the new development, some will wish emphatically to take part in the advances which lie ahead. The instruction must be sufficiently flexible to deal with and interest all these men and meet their respective needs.

Course of Instruction

As soon as we begin to plan our courses we meet the age-old problems of education. Shall the training be systematic or shall the instruction and influence be conveyed by personal daily contact and observations of the practice of the great masters of the subject? In England we have both schools of thought, embodied as frequently with us, in ancient foundations. The University of London inclines towards the former view and

systematic teaching, the Royal Colleges of Physicians and Surgeons to the latter. In regard to the teaching of physics, however, there can scarcely be any choice. Physics is here an ancillary; too great emphasis on purely physical studies is out of place and the teaching, I believe, must take the form of systematic courses of lectures and practical demonstrations. This is particularly important in view of the relatively small knowledge of physics enjoyed by most students entering the course. Regulations frequently lay down that a knowledge of physics equal to that of the First M. B. (that is, medical undergraduate course) is assumed, but sad experience reveals the necessity for a revision of such portions of the general physics course as are required for our special purposes. There must be adequate laboratory experimental work by the students themselves. Physics is an experimental science, to be learnt in the laboratory rather than the lecture room. It has frequently been my experience to meet students, whose knowledge on paper of the writings of learned professors was astonishing, yet who were quite innocent of the arts of wiring the simplest circuit or carrying out the easiest investigations for themselves. Many of the words they had learnt had meant precisely nothing to them. The laboratory is also an admirable place to get to know the students individually and to vary the instruction according to individual needs. This insistence on laboratory teaching also avoids another of the most awkward problems. By training, and therefore inclination, medical men do not generally enjoy mathematical argument. The sight of an integral sign is a cause of intense depression and unrest. The mathematical approach, so dear to the physicist, is, except in a few rare instances, closed, leaving the experiment as the sole gateway to the subject. What could be better? We have found that students enjoy properly planned experimental work and gain more confidence than by any amount of lecturing. We remark that the experiments must be carefully arranged to demonstrate at the same time fundamental physics and radiological application. A gold-leaf electroscope is doubtless an electrostatic voltmeter of low capacity, but may be designed and made in such a way and of such materials as to exemplify all the fundamentals of dosage measurement in roentgens.

The syllabus of a course of instruction in physics for the Diploma in Medical Radiotherapy of the Royal Colleges of Physicians and Surgeons is shown below:

Physics in Radiotherapy. — Elementary electricity and magnetism. Electrostatics and current electricity, including alternating currents. Electromagnetic induction. Transformer and induction coil.

Introduction to study of electromagnetic radiations. Wave and quantum theories. Elementary study of structure of matter. Cathode rays. Thermionic emission. Cathode-ray oscillograph. Roentgen-rays. Properties and nature. Absorption of roentgen-rays by

so ids, fluids. Variation of absorption with wave-length. Roentgen spectra. Scattering. Co npton effect. Secondary radiations. Absorption by scatter, fluorescence and nuclear in eraction. Ionisation of gases. Measurement of roentgen-rays. The roentgen.

Dosage measurement. Instruments for measurement of dose and dosage-rate. Standa d ionisation chambers. Spectrographic and absorption methods of measuring quality. Ba kscatter. Depth dose. Percentage depth dose. Physical conditions on which these qu ntities depend. Distribution of radiation in tissues. Isodose surface. Integral dose. Ra liation technique. Applicators. Mechanical and optical devices for beam direction.

Radioactivity. Radioactive substances. Disintegration theory. Radioactive equilibri m. Radioactive families. Physical properties of alpha, beta and gamma rays and the ir absorption in matter. Neutrons. Physical laws of, and apparatus appropriate to, int rstitial, surface, intracavitary and teleradium therapy. Methods of preparation and use of radon. Artificial radioactivity.

Electrotechnics. — Construction and action of A. C. and D. C. generators and motors, rotary converters, high tension transformers, relays, rectifiers. Protection against electrical dangers and accidents. Production, control and measurement of high voltages for therapeutic use. Roentgen tubes, valves, high tension circuits. Constant potential circuits and voltage multipliers. Protective measures against radiation and electrical dangers. International recommendations.

It represents an attempt to outline however imperfectly a course not just of physics, but physics applied to therapeutic radiology, and must be interpreted as such. The whole emphasis is on the physical basis of radiation therapy, not pure physics. A course must be modern in outlook and is then easily made attractive to the student.

At my own hospital simultaneously with a course of elementary electricity and magnetism, we deliver fairly advanced lecture courses on radiation physics and on roentgen and radioactive technology respectively. Later, other lectures deal in considerable detail with the physical basis of specific techniques used by us. For example, after lectures on the measurement of gamma rays we discuss in detail the physical principles of radium dosimetry as they occur in the treatment of carcinoma of the cervix, a study which serves admirably as an example of the fundamental laws of radiation distribution in tissues due to contained sources and illustrates the many difficulties of accurate radium dosimetry in practice. Following lectures on the general principles affecting depth dose in roentgen therapy these principles are exemplified by a detailed discussion of perhaps the distribution of radiation in the treatment of cancer of the oesophagus. After the study of the purely physical principles and technology of telecurie therapy, we embark on a description and analysis of the actual distribution and dosimetry used in perhaps the treatment of intrinsic cancer of the larynx. Detailed studies of the radiation distribution in tissues resulting from various arrangements of radioactive sources or of radiation beams are discussed and analysed, together with the means available in practice for making them. The examples chosen are techniques whose physical basis happens to have been of particular

interest to us, but others in the personal experience of the teacher would serve equally well. In this way the student sees for himself the practical application of the physical principles and ceases to be querulous, and I think rightly querulous, as to why he »has to learn all this physics».

Incidentally, in order to teach such a subject effectively the physicist himself must learn a curious basic geometrical-anatomy which serves to bridge the gulf between the pure geometry of radiation distribution and its application in practice.

My own criticism of our teaching would be that there is still too great emphasis on 'classical' physics as frequently taught to the exclusion of medical physics to unfortunate undergraduate medical students, grouped together in a class with engineers and others. Over several years we have gradually eliminated as much as we dare of this redundant physics and increasingly emphasised principles of real radiological importance, introducing definitely radiological and medical experiments and examples throughout. The course must train the student for the understanding of the radiological tools of the future as well as of the past, always taking care to discard as well as accrue, to avoid overloading an already formidable syllabus.

Another serious criticism of our present course is, I believe, the relatively small fraction of the time devoted to the study of the physical basis of biological effects and more important still to the study of those effects themselves. We have, however, been careful to include two or three lectures on these subjects by outside experts and I believe the time is ripe for the introduction of laboratory experimental work on the biological effects of radiations.

Below (page 19) we give a list of the experiments to be carried out in the laboratory by our own students. It will be noted that it contains many roentgen-ray and gamma-ray measurements, for example, of dosage-rate, backscatters, depth doses etc., and also the use of contour projectors, dose finders, and other geometrical devices used in practice, so that the student becomes acquainted with the dose distributions resulting from pointing beams of radiation of various kinds into the patient (represented in the laboratory by a hollow plaster cast, or wire framework) and of devices used in many centres for accurate beam direction. Infra-red and ultra-violet measurements are also included as well as experiments on localisation of 'foreign bodies' in wax models using a mobile diagnostic roentgen-ray plant, thus exemplifying the physical and geometrical principles involved. True, we have had therapy students complain that this was a diagnostician's job until it was pointed out that it is difficult to estimate dose or even direct beams of radiation accurately unless one knows where the tumour is.

Normally the course commences early in October and the physics examination is held late in March or early April of the following year. Three lectures a week are given, each of about one hour, followed by two hours experimental work in the laboratory; that is, three afternoons a week are devoted to the physics during six months of the session. In practice the number of laboratory attendances necessary to complete the experiments diminishes gradually so that perhaps two a week suffice in February and one in March, the emphasis gradually changing to the clinical part of the course.

It must be admitted that there is danger of over-emphasis of physics in the students' mind prior to his examination even if the fraction of the time officially devoted to the subject is relatively small. The whole course for this and other reasons, has recently been extended to two academic sessions, which should have great advantages, enabling one year to be devoted to systematic instruction in the more academic portions of the subject, both clinical and physical, and the second to an apprenticeship and real introduction to clinical radiotherapy.

The Examination

Experienced teachers, conscious of the gap between aims and achievement in education, may become a little cynical on hearing of the aims of a given specialised education and ask anxiously about the control and nature of the final examination. Certainly, however exalted our aims if our students do not pass the examinations we are likely to find ourselves with but very few to teach!

The type of examination is therefore very important and our own practice is not without disadvantages. Normally two papers are set (each three hours) for physics in medical radiology, one paper primarily technical and the second dealing with underlying physical principles in medical radiology. Emphasis must clearly be on fundamental principle, not detail.

An interview with each candidate is essential and at the moment we have also an examination in practical physics. So far as possible these practical tests consist of radiological exercises but frequently if a large number, say fifty, students, have to be examined it is impossible to provide simultaneously sufficient roentgen equipment, diagnostic or therapeutic, or radioactive experiments for the tests to be really appropriate. The experiments set tend therefore to be of the 'Wheatstone bridge', 'Temperature coefficient of resistance' order, since most teaching laboratories of medical schools have a large number of such pieces of apparatus. The tendency is unfortunate and it may be preferable to have an interview with apparatus available, so that if the examiner wishes

he may ask for some definite radiological test such as localisation of a foreign body, measurement of dose, a demonstration of how to set fields accurately on a patient, or the calculation of dose from a radium applicator or telecurie unit. We should nevertheless beware of any tendency to minimise the importance of practical instruction in the laboratory.

Teaching of Physics in Diagnostic Radiology

There has been relatively little argument as to the teaching of the diagnostician in physics. It is usually felt that he needs to know less physics than the therapist and that all that is required is some knowledge of the difference between a half-wave and full-wave rectification!

It is easy to see how this unfortunate state of affairs has come about. Diagnostic radiology seems to rely less than therapy upon its technical weapons. Partially, at least, the opinion is the fault of physicists themselves. The physical principles of diagnostic radiology have been far less extensively studied, yet they are at least as worthy of study. Substitute the photographic film for the ionisation chamber and the problems of depthdose can be translated almost literally into diagnostic questions of the highest importance. For 'dose' substitute 'exposure' and a whole new range of questions, or rather old problems in new dress spring to view.

We see in this field the effects of neglect of research. We need very greatly centres devoted to the physical problems of diagnostic radiology and equipped with facilities, staff and material analogous to those developed on the therapy side. Such centres would assuredly reap a rich reward and would in turn train men with more interest in the subject to act as pioneers of the next generation. The truth, I believe, is not that diagnosticians need less physics but that they do need different physics, and that in many cases the physical principles are not yet sufficiently understood to constitute the basis of a satisfactory course of instruction. With the importance rightly placed on early diagnosis of malignant disease might not technical advance in diagnostic radiology be at least as important as, say, the use of higher voltages. Cannot the new tools of physics find a place here? Already the electron multiplier seems destined to supersede the older timing devices. Might not the scanning techniques of television, the methods of amplification of photo-currents, the development of pulse techniques to instantaneous radiography and a hundred other tools of modern physics be applied? And might not the practice and teaching of diagnostic physics be revolutionised thereby?

Again, we have tried to adapt the teaching to the real needs of the case, but with less success I think than with therapy. The courses of physics for therapy and diagnosis have with us a common portion dealing with

t e nature of electromagnetic radiations, the fundamental physics of r entgen-rays, but omitting much of the detailed dosimetry, though even a diagnostician should know the meaning of a roentgen. The second part o the course deals with diagnostic technology and such subjects as the p ysics of the photographic emulsion, fluorescence or the geometry of s adow formation. The scope may be judged from the following syllabus, a ain of the Royal Colleges of Physicians and Surgeons.

Physics in Medical Radio-diagnosis. — Elementary electricity and magnetism. E ctrostatics and current electricity, including alternating currents. Electromagnetic in uction. Transformer and induction coil.

Introduction to study of electromagnetic radiations. Wave and quantum theories. Elementary study of structure of matter. Cathode rays. Thermionic emission. Cathode-ray oscillograph. Roentgen-rays. Properties and nature. Absorption of roentgen-rays by solids, fluids: Variation of absorption with wave-length. Roentgen spectra. Scattering. Compton effect. Secondary radiations. Absorption by scatter, fluorescence and nuclear interaction. Ionisation of gases. Measurement of roentgen-rays. The roentgen.

Physical and geometrical principles of diagnostic radiology. Formation of shadows of stationary and moving objects. Factors affecting sharpness, size and shape of shadows. Geometry of localisation. Tomography. Kymography. Practical applications. Fluorescent screens. Radiations from screens. Advantages and disadvantages of different types. Luminosity of screens. Photographic effects of radiations. Development. Fixation. Intensification. Theory of photographic action. Blackening. Photographic density and its measurement. Characteristic curves of photographic materials. Films, papers. Contrast, speed, sharpness. The eye. Visual acuity. Adaptation. Accommodation. Stereoscopic vision. Stereoscopes.

Electrotechnics. — Electrotechnics, including construction and action of A. C. and D. C. generators and motors, rotary converters, high tension transformers, relays. Protection against electrical dangers and accidents.

Diagnostic roentgen apparatus. Construction. Care of apparatus. Production of roentgen-rays. Measurement of high tension and currents. Diagnostic circuits. Rectification. Rectifiers mechanical and electronic. Full and half wave. Voltage drop. Wave form distortion with high loads. Roentgen tubes. Limitations of loading. Line focus. Rotating anode tubes. »Exposure.» Current and voltage measuring instruments. Milliampere-second meters. Time switches. Stabilisers. Methods of reducing secondary radiation. Cones. Potter-Bucky diaphragms and grids of various types. Correlation between electrical conditions and photographic effects of roentgen-rays. Protection. Direct radiation from tube. Scattered secondary radiations. Integral dose. International recommendations.

Medical Physics Department

With these courses and examinations in mind we now turn to discuss th necessary personnel and facilities. First, it is clear that the teaching m st be carried out in specially equipped departments. In England at le st, the medical schools of many colleges have not the facilities and pe sonnel required. Certainly the pure physics departments of univer-si es have not the requisite outlook or experience and the practice of

attempting medical physics teaching in the normal physics department is not satisfactory. A department of medical physics must be situated, if it is to be effective, in a hospital with active research in progress, and must itself be engaged in fundamental medical research. It should be responsible, not only for the teaching of medical physics, but also for the physical aspects of radiation treatment and for the whole range of physics in the hospital. It is an advantage for teaching to be carried out by several members of such a department, as this arrangement adds to the interest, and incidentally affords a useful supplement to the salaries of junior members of the staff. It is interesting to observe the effect on students of medicine of working in a department with an active physics organisation, as the importance and significance of physical methods is brought more vividly to their minds. The necessity of having physical research in medicine simultaneously with education in the subject is very marked. Members of the teaching staff must be themselves actively engaged in some problem of their own if they are to be lively interesting teachers; though perhaps it is a good rule for experts in too narrow a field never to be allowed to teach their own special subject!

The scope and activities will clearly depend upon the size and status of the department involved. If a single physicist be employed, in England he will probably be a member of the staff of the radiotherapy department and his time largely occupied in the immediately useful tasks of caring for roentgen equipment and radium, making routine measurements and the like. It is, I think, important that there should be other departments of medical physics, separate though closely allied to the Medical departments, and under the control of a medical physicist of some authority with University status (preferably occupying a Chair in the subject). In such circumstances a much wider range of research can be carried out by a nucleus of permanent personnel, while young physicists may be appointed, preferably to take higher degrees and to be trained in medical and biophysics. It is of considerable importance that such a group keeps contact with the pure physics department of its University, since it is all too easy for medical physicists to become so immersed in their own speciality as to lose touch with the main stream of advance in physics in the long run to the great detriment of their own work.

In such a department fundamental research may be undertaken and technical advance attempted a little removed from the severe pressure of the daily clinical round. Such a biophysics department must also either have on its staff, or have available, the services of expert biochemists, cytologists, cell physiologists and other specialists if its work is to be of the highest order.

Even in our own very specialized institution we find that work

ranges from electrocoagulation, diathermy, optical instrument care and design to microphotography, electrocardiography and many other subjects. In a general hospital the range is probably even wider.

»Routine» Medical Physics

The responsibility of the physicist cannot end in the laboratory with the solution of a problem of radiotherapeutic or other medical physical technique. In collaboration with his medical colleagues he must so organize that the knowledge and experience gained is applied in the treatment of the individual patient. This is often not easy. The radiotherapist is perhaps as yet only half convinced of the advantages of the particular apparatus or procedure; the physicist himself is hurrying on to some other, now more interesting, problem. The radiotherapist has so many other considerations in his mind! The physicist is a little weary of isodose curves and volume distributions.

We have tried to solve the problem in radiotherapy (a) by simplifying so far as possible the conditions of treatment; (b) by devising simple geometrical methods of obtaining from standard isodose curves the complex distributions of radiation in the tissues, as well as the development of beam directing instruments and direct dosage rate meters, and (c) by training radiographers, that is, technicians, who largely take over, under supervision, the routine applications and measurements.

With respect to (a), simplification of techniques, I mostly mean the reduction to a reasonable number, of field sizes and filters in roentgen therapy or the use of families of field groupings. The second point (b) is of extreme importance. Unless we can devise instruments which, while ensuring accurate beam direction or precise dose finding and measurement actually make easier the operations involved, the techniques may be shown to visitors but they will die a quiet death when the doctor's back is turned. Here good instrument makers with well equipped workshops become essential. This instrument shop in my experience soon becomes the centre of the medical physics department and will lure the physician, the surgeon and the radiotherapist to discuss details and ideas with physicist and instrument maker alike and result in closer and more fruitful collaboration.

The organisation of this type of work will clearly depend on a good many factors. I can only describe our own attempt at a solution. The radiotherapy patient after the normal medical clinics (at which it is very valuable for a physicist to be present and see the real problem, not as a neat diagram on paper but in all the complexity of the reality) attends a special 'Measurement clinic'. Here the rough recommendations from the radiotherapist as to techniques of treatment, field sizes, kilovoltages

etc. are made precise. Instruments are kept ready to measure cross sections, dimensions etc., while with a 'clinical dose finder' the treatment is as it were 'rehearsed', the optimum angles defined precisely and doses found quickly at the sites regarded as of most interest. If required, the necessary measurements are made for a 'volume distribution'.

The subsequent plotting of radiation fields is then carried out by a specially appointed radiographer. If suitably chosen and trained such radiographers become very skilled and proficient, and we have found the work to be admirably carried out by young women with some previous science training. Everything depends on this organisation for difficult personal problems requiring tact as well as a knowledge of isodose curves are bound to arise. Such radiographers can also investigate new techniques and carry out small pieces of research on the effects, say, of a new size of field, the effects of alternative angulations of beams. The radiographer in charge is, in our own case, assisted by two radiographer students who spend a month or two months in the Physics Department as part of their training and become fairly well acquainted with the use of the relevant physical instruments. These radiographers also make measurements with Sievert condenser chambers carried in routine protection investigations, all of course under the supervision of a senior member of the Physics Department. We are at present training radiographers in counting techniques for clinical work with radioactive isotopes. All this is easily organised and after some training ensures in practice the application of an order of accuracy in technique which seems otherwise unapproachable.

It is clear that the routine calibration of roentgen plants, measurements of output, checks of alignment of beams, maintenance of standards of dose, care and custody of radium, are all functions of the medical physics department but call for little comment. On the whole it seems preferable to organise the work so that all members of the department take some 'routine' responsibility and are at the same time engaged in work of a more academic character, whether fundamental biophysical work or applications of known techniques or the development of new techniques to the investigation of practical radiological problems. The range of research may with advantage bridge the gap between the extreme of solving the day to day clinical-physical problems and the most abstruse investigations in biophysics and allied sciences.

The most important factor is however not organisation but personal collaboration between doctor and physicist. If the physicist does not realise that for all his academic attainment, his function in the hospital is to be useful and that ultimate responsibility rests with his medical colleagues; if the radiotherapist does not become acquainted with the research laboratory, not occasionally but as part of the days work,

little will be accomplished. The daily contact and sense of unity of purpose of the departments, even though separately administered, is the key to the situation.

Physics in Radiation Therapy

Finally, I think we should face squarely a question as to the value of physics in medicine, particularly perhaps in relation to therapy. Can we justify the undoubtedly serious outlay in men, time and materials?

First, I would be sorry to leave with you the impression that I thought that the radiological treatment of cancer is just a branch of applied physics and a rather simple exercise in three-dimensional geometry. No-one in their senses would really think so. We recognise that the infinite complexity and importance of the medical and indeed personal problems must overshadow the technical achievement. What then do we expect to attain by insistence on this physical control and precision? Are the results of treatment as assessed, let us say, by five-year symptom-free rates, definitely improved thereby? I would hesitate to give an unqualified 'yes' in answer to any such question. We often find the results of our efforts very disappointing. For example my colleague, Professor SMITHERS, with some of my young physicists studied very carefully the physical principles underlying treatment with high-voltage roentgen-rays of cancer of the oesophagus and a real effort was made to improve the physical and technical aspects of the treatment. The results viewed statistically, are still appalling. It is clear that in such circumstances no improvement of accuracy of dosimetry by 10 % is going fundamentally to affect the problem. Here we are faced, as so often, with questions of a very different kind and of an order of magnitude which precludes any advance along purely physical lines. Nevertheless we may at least now be sure that our failures are not due to careless or inadequate dosimetry and the real causes stand out more certainly. It must never be forgotten that if the disease has ceased to be strongly localised then no amount of precision of dosimetry at the primary tumour can ever solve the problem. In all fairness it must be added that the immediate and palliative results were considerably improved by the introduction of the new physical techniques of beam direction and dosimetry. It is also interesting that post-mortems performed on patients treated by the more rigorous techniques showed in a greatly increased number of instances no evidence of residual primary tumour, the patients having died from spread outside the treated area or perforation of the oesophageal wall. The greater care in technique had clearly improved the results of treatment of primary lesions.

It seems that the sites to which it is now worth while devoting our

attention from the physical point of view may be those giving intermediate results. If, as in the treatment of some skin tumours, we may expect 95 % five-year symptom-free rates, a little extra physical accuracy cannot cause much improvement. If the results are extremely bad the same conclusion would seem to hold. We cannot expect striking improvement unless we have a fundamentally new set of circumstances. We are, for example, very interested in the possibilities of treating bone tumours at 30 Mev. because there are good theoretical reasons for expecting special energy absorption in bone under these conditions.

It has sometimes been urged that cancer is not a disease of spherical masses and point sources, cylinders, rings, discs and line elements; therefore the mathematical and physical solutions to the problem are ridiculously inadequate. We know from bitter experience that the solution is frequently inadequate but since we often do not know exactly what volume of tissues we should irradiate we are quite justified in assuming them to be simpler than in fact they are. Moreover, the solution of the simple cases soon leads to good approximations in the complex ones. We might moreover argue that a great many early tumours are in fact approximately spherical in shape and that the assumption is not as wild as sometime pretended.

Justification of the application of physics in such detail is to be found partially in the decreased number of major catastrophies compared to the results with techniques less rigorously controlled. One advantage of careful physical studies as a routine is that it is possible to approach the edge of the 'dosage precipice' with far greater safety. Also the uniformity of reactions is improved, 'hotspots' are eliminated or reduced, and generally the passage of the patient is, on the whole, made easier. Moreover, there was a school of thought which seemed to insist in the early days of radiation therapy that the cure of cancer was merely a question of obtaining a sufficiently large dose at the tumour. The ability to give these larger doses safely has shown conclusively that this is not so, and that other much more subtle factors are involved. Maybe we could have anticipated this result but it is now more certainly established. The habit of thinking of tumour dose rather than skin dose focuses the clinicians' attention on the tumour and even contributes to his desire to find out for himself what is happening at a depth, an excellent development. Again, the accurate comparison of results between different clinics using different techniques might have been thought to be made easier with the carefully standardised dosimetry but in reality the nature of the original material, the degree of selection exercised either explicitly or implicitly, forces the conclusion that the results of such comparisons are indeed difficult to interpret. However, internally, that is in the same clinic, effects of changes of technique are certainly more accurately assessible.

I would add one other consideration. It is sometimes maintained that the influence of physical studies is to impose a kind of cast iron regime on the treatment which cannot therefore be adapted to the needs of the individual patient. It is said that standardised techniques and standard doses, magic numbers like 300 and 6 000 r begin to appear; all becomes formal and rigid. Accurate, the treatment may be, but unintelligent and cramped. Nothing I believe could be further from the truth. It is in fact only through elaborately studied physical techniques that rational and relatively safe flexibility becomes possible. For example, in the treatment of cancer of the cervix uteri with radium we have during the last few years become aware, through our studies of three-dimensional dose distribution, of the variations of dose which occur at critical sites from patient to patient. We thought that it must be so, but now we have some numerical idea of the variation. It is only by such physical studies that the amounts of radium can be satisfactorily adjusted to the sizes, shapes, deformations of the pelvic structures, or the beginnings of quantitative combination with roentgen-ray fields even attempted. In every case the final criterion is biological effect. The aim is not to give 6 000 r but to evoke a certain tumour response. The dose must still be adapted to the particular patient but the physical studies provide the background for this individual adjustment. Certainly we are far from the solution to all the problems but at least we have acquired from the physical studies a more lively appreciation of their existence and magnitude, and significantly enough, a freedom in technique which previously we did not enjoy.

There is, however, one other question to which I would dare to give a more certain reply. Have the physical studies provided a sounder and more secure basis for the developments of the future? Here the answer is certainly 'yes'. We can now begin to undertake the correlation of physical and biological phenomena. We may even begin to predict very cautiously the course of events, a remark which leads me to a rather curious observation. I have often noted how by so-called 'empirical methods', that is in fact by astute observation and great experience, clinicians have devised techniques which when examined physically are seen to be very nearly what would have been designed from quite another point of view. This phase of quietly following events is, however, I believe, passing. For example, faced with unprecedented questions such as protection against streams of neutrons or the use of very high energy quanta we can begin, admittedly very tentatively and more than a little uncertainly, to predict what we may allow, what total energy in absolute units the body will tolerate and generally to proceed with more confidence into the unknown. At very high voltages a large amount of experimental work on gamma rays and roentgen-rays has shown that we may

expect a great rise of energy absorption below the surface. Skin reactions are likely to be relatively very small; clearly a very dangerous situation and one which will call for the most exacting combination of anatomical and physical information. We can at least guess from purely physical investigations some of the differences to be expected with different radiations and be on our own guard in certain conditions and situations. The value of wide generalisations of a quantitative character becomes more obvious even in a biological and medical field. Many other examples of the same kind might be cited. The basis of dosimetry of ingested or injected artificial radioactive substances proves to have been developed already in our studies of radiation distribution around our more classical sources. The mathematical theory of integral dose, which looks a little academic in its original setting, is already proving a reliable guide in the new fields. Our physical and mathematical weapons stand ready to meet new foes and complete the conquest of old ones.

My own impression is that the pure physics has now somewhat outrun biophysics and clinical practice, and we would be wise to throw our resources into the more biological aspects of the subject using the physical weapons now forged. Let me hasten to add that there is still plenty of pure physics required but we must beware of the pursuit of the next decimal point when whole regions of fundamental ignorance confront us in the same problem. One of the main obstacles seems to be the lack of trained and experienced experimental biologists and cytologists to carry out the work and my plea is here to university authorities and others responsible, to devote funds and facilities to this training and research in biophysics and allied subjects. These fields are self-fertile. When the need for more biological work is realised, in a few years more radiation biology will be taught, more interest will be raised and a corresponding increase in men and funds become available. The time will surely come when the experimental biologist must take a larger share in the education of the radiotherapist.

So in terms of technical perfection we might attempt to justify our emphasis on physical studies. Yet surely this is not all. Shall we not rather assert that our main aim must be to educate rather than instruct? We look rather to intellectual development and the formation of sound habits of mind, than to ingenious gadgeteering, as the sure ground on which the future shall be built. I for one would not apologise for Physics, and I think you would not wish me to do so. True, at a time of confusion between the meaning of 'pure science' and of 'technology' and of appalling misuse of the powers provided by both, here in medicine we have an application of physics of which we may assuredly not be ashamed. Yet the justification must still be the quest for knowledge for its own sake. I do not need to tell you that the quest will of itself bring rich rewards.

List of Practical Experiments in Physics at the Royal Cancer Hospital (Free) for Diploma in Medical Radiology

Electrostatics.

1. Gold leaf electroscope. Measurement of volt sensitivity and capacity. Measurement of current in absolute electrostatic units.
2. Quadrant electrometers. Comparison of e. m. f's.
3. Lindemann electrometer. Measurements with condenser chambers.
4. Discharge of condenser through high resistances.

Direct current effects.

5. Constant of tangent galvanometer by electrolysis. Calibration of ammeter using tangent galvanometer.
6. Ohm's law. V and A across constant and variable resistances.
7. Potentiometer. Comparison of e. m. f's.
8. Wheatstone bridge. Measurement of specific resistance.
9. Post office box. Temperature coefficient of resistance.
10. Heating effect of a current. Calorimeter experiment to determine the mechanical equivalent of heat.
11. Ballistic galvanometer. Comparison of capacities and e. m. f's.

Alternating currents.

12. Measurements of self-inductance, mutual inductance and capacitance using A. C. and D. C.
13. Characteristics of transformers. Secondary volts and amps against primary volts and amps. Hysteresis.
14. Metal rectifiers. Experiments with A. C. and D. C. instruments.

Non-ionising radiations.

15. Use of light sources and photo-cell. Inverse square law and distribution about various sources.
16. The diffraction grating. Measurement of wavelength.
17. The spectrometer.
18. The ultra-violet spectrograph. Fluorescence. Output of different sources. Distribution of energy in spectrum.
19. Selective absorption of ultra-violet light.
20. Photo-electricity. Photo-electric emission from plates of different materials under the action of ultra-violet light.
21. Infra-red. Measurements of intensity from various sources using thermopile; vacuum thermocouple.

Roentgen-rays.

22. Measurement of tube voltage using sphere gap.
23. Variation of tube current and roentgen output with kV.
24. Variation of dosage-rate with distance and tube current.
25. Absorption of roentgen-rays in wax. Variation with kV. and filtration. Half-value layer.
26. Backscatter. Variation of percentage backscatter from wax with area of field and quality of radiation.
27. Percentage depth dose in wax. Variation with area of field, focal-skin distance and quality of radiation.
28. Pin-hole camera. Examination of target of various tubes.
29. Photographic effects of roentgen-rays. Use of step wedge and densitometer. Characteristics of emulsions. Effects of screens.
30. Methods of localisation of foreign bodies, using portable diagnostic apparatus.
31. Protection measurements during all experiments.

Radium.

32. Beta-ray electroscope. Absorption of beta-rays in aluminium.
33. Gamma-ray electroscope. Absorption in lead and comparison of strengths of radium needles and radon seeds.
34. Auto-radiographs of radium needles. Leakage test.
35. Use of contour projector. Isodose surfaces.
36. Determination by various methods of distribution of radiation in models of patient. Dose finder. Clinical dose finder.

Electronics.

37. Thermionic emission. Characteristics of diode, triode, tetrode and pentode.
38. Use of triode as amplifier of A. C. and D. C.
39. Use of Geiger-Müller counter.
40. Use of diode as rectifier.
41. Use of diode as voltmeter.

SUMMARY

Some general problems of education of a medical student, whether undergraduate or postgraduate, in physical sciences are discussed, particularly in relation to modern developments in nuclear physics. It is thought that the education of the radio-therapist in physics must convey to him something of the methods and power of physics and its gathering momentum in clinical work and experimental biology as well as radiation therapy itself. Details are given of courses of instruction in physics in England for undergraduate medical students, as well as Postgraduate Diplomas both in Radiation Therapy and Radiodiagnosis.

The responsibility of the physicist does not however end with the solution of problems of radiotherapeutic technique. The difficulties involved in the organisation of research and routine medical physics in relation to therapeutic practice are therefore discussed and tentative solutions proposed. Finally, an attempt is made to assess the value of physics in medicine, particularly in radiation therapy. It is emphasized that mere technical achievement is not sufficient or adequate. Intellectual development and the formation of useful habits of mind are the aims of any effective education of medical men in physical science.

ZUSAMMENFASSUNG

Allgemeine Probleme der Ausbildung eines Medizin-Studenten in Physik werden besprochen, sei es dass sich um einen Anfänger handelt oder um den angehenden Spezialisten. Besondere Berücksichtigung findet die Beziehung solcher Ausbildung mit den modernen Entwicklungen der Kern-Physik. Es wird betont, dass die Ausbildung des Strahlentherapeuten in Physik ihm das Wesentliche der physikalischen Methodik und die ausserordentlichen Bedeutung von Physik für klinische Arbeit, experimentelle Biologie und Strahlentherapie vermitteln muss. Es werden Details der Ausbildungskurse in Physik gegeben, die in England für den Studenten der Medizin und den angehenden Spezialisten in Strahlentherapie und Röntgendiagnostik abgehalten werden.

Die Verantwortung des Physikers endet nicht mit der Lösung von Problemen der Bestrahlungstechnik. Es werden daher die Schwierigkeiten der Organisation von Forschungsarbeit und medizinisch-physikalischer Routine-Arbeit in Zusammenhang mit der strahlentherapeutischen Praxis besprochen und Anregungen zur Lösung vorgebracht. Die Bedeutung der Physik für die Medizin, im besonderen für die Strahlentherapie wird besprochen. Es muss betont werden, dass lediglich technische Vervollkommnung nicht das letzte Ziel ist. Eine bestimmte intellektuelle Entwicklung und die Formung einer zweckdienlichen Mentalität sind das Ziel jeder guten Ausbildung des Mediziners in Physik.

RÉSUMÉ

L'auteur discute de certains problèmes généraux touchant l'enseignement des sciences physiques aux médecins, étudiants ou gradués, particulièrement la partie ayant trait aux développements modernes de la physique nucléaire. L'opinion soutenue est que l'instruction accordée au radiothérapeute en physique doit lui donner une idée des méthodes et pouvoirs de la physique, de même que de l'importance croissante de celle-ci aussi bien dans le travail clinique et la biologie experimentale que dans la

thérapeutique des rayons eux-mêmes. Une description détaillée est donnée d'un cours de physique pour les étudiants en médecine, ainsi que du cours de perfectionnement pour le diplôme de Radiothérapie et de Radiodiagnostic.

Les responsabilités du physicien ne se terminent pas cependant avec la solution des problèmes de technique radiothérapeutique. Les difficultés soulevées dans l'organisation des recherches et de la physique routinière en vue de la pratique thérapeutique sont discutées avec des tentatives de solution. Enfin l'auteur tente de démontrer l'importance de la physique en médecine, particulièrement en radiothérapie et appuie sur le point qu'un simple succès technique n'est pas suffisant. Un développement intellectuel et la formation d'un état d'esprit pratique sont le but de toute instruction efficace des médicins dans la science de la physique.

FROM THE ROENTGEN CLINIC OF THE TOWN AND COUNTY HOSPITAL, ODENSE, DENMARK
(CHIEF: PAUL JACOBY, M. D.)

ON HYSTEROSALPINGOGRAPHY AND EXTRA-UTERINE PREGNANCY[1]

by

Henning Skjoldborg

The clinical diagnosis of tubal pregnancy in the complicated cases — rupture of the tube and tubal abortion — is seldom difficult. In these cases there is no need for hysterography, because the accompanying symptoms are so characteristic that there cannot be any doubt; besides, the acute condition calls for swift intervention. There remain the cases of extrauterine pregnancy in which the pregnancy continues till up towards the time when the delivery is expected. These are extremely rare, however, and numerically of slight importance. Finally, there are the cases one most often sees; namely, the slowly proceding tubal abortions with periodical hemorrhages and formation of hematocele. It is in these that the differential diagnosis is most difficult, and chiefly in these that hysterosalpingography may be of some assistance.

According to DYROFF (1) it should be possible as contrast picture in early extrauterine pregnancy to demonstrate atony of the uterus and at the same time absence of ovum shadow in the latter and lack of filling of the tube on one side. But after several indubitable cases of extrauterine pregnancy had been published, in which no such atony could be demonstrated, this simple formula had to be given up.

On a purely theoretical basis it is possible, as shown by SCHNEIDER & EISLER (11), to imagine how the hysterosalpingographic will look in a case of tubal pregnancy. One will find a salpinx whose lateral part is slightly swollen, trumpet-shaped, with an obstruction to passage laterally. In the typical, obvious cases, one sees a thin contrast line, which continues between the wall of the tube and the filling in the latter (the hematocele?). Besides, one will see a net-like contrast tracing, which continues to lie isolated and clearly marked off from the rest of the contrast medium. Theoretically, this can be explained as the result of a small quantity of the

[1] Submitted for publication, Nov. 19, 1947.

contrast substance having distributed itself in a very thin layer between the ovum and the wall of the tube. From Denmark (9, 10), there has hitherto been published 12 cases, in 6 of which hysterography showed a similar picture. (The diagnosis of extrauterine pregnancy was here made in 25 cases, but in 13 of them it proved to be wrong.)

In our service we have succeeded in obtaining these highly characteristic pictures in 3 cases, and since the diagnosis was in all of them confirmed by operation, we believe it of interest to report them here. Our procedure has been the one indicated by KJELLBERG (5), with only a slight modification. A Günther-Schultze apparatus was inserted, and was held in place by means of two forcipes in the portio. Without use of manometer, a 25 per cent solution of perabrodil, to which had been added 1 per cent of procaine hydrochloride, was injected under very slight pressure. On the average, 20 to 40 cc. of contrast fluid were used. In no case was there any trouble or any discomfort to the patient either during the examination or afterwards. We ascribe the good results entirely to the use of a substance soluble in water instead of an oil solution, because the water-soluble perabrodil distributes itself more evenly and more rapidly through the small cavities of which there may be question here.

Case 1. (Record no. 305/47.) — Married woman, 29 years old. In 1944 treated in another hospital for extrauterine pregnancy, with right-side salpingo-oophorectomy. Now admitted to gynecologic service on account of irregular hemorrhages. No subjective symptoms of pregnancy. Gynecologic examination revealed on the left side an ovoid, firm, solid, displaceable, not tender intumescence. Microscopy of the uterine mucosa showed the endrometrium in a phase of proliferation, with portions of it shrinking, and parts of a myofibroma.

Hysterography (Fig. 1) showed a roughly shaped, perhaps a little large, uterine cavity measuring 4 × 4 cm. On the right side was seen a slight inflow of contrast fluid into what was presumably an intramural remnant of the salpinx. The medial two-thirds of the salpinx of the left side looked normal; beyond that it became more and more distended, until it in the ampullar portion attained a diameter of 1 cm. It ended abruptly at a bizarre ovoid formation 5.5 + 3 cm. in diameter. The contrast fluid distributed itself only very thinly over this filling, forming a net-like, masking design, which in the periphery was delimited by a very thin line of contrast substance. There was no outflow into the peritoneum. The whole picture was strongly suggestive of extrauterine pregnancy.

The surgical operation confirmed the hysterography. A twisted tube twice the diameter of a thumb was found in the left side. Only the distal one-third to one-half was thus distended, the other portion was normal. The ovary was adherent to the fimbriae and contained a thick-walled cyst, the size of a small apple. Tubectomy was performed and the left tube resected. The tubal wall was not ruptured, but in one place it was very thin, and there was a small portion, about 1.5 cm. in diameter, where the coagula shone bluishly through. An incision was made and a coagulated mass, the size of a green walnut, squeezed out. Microscopy showed hematoma of the tubal wall.

Renewed hysterography several days after the operation (Fig. 2) showed that the uterine cavity now was smaller. It measured 3 × 3 cm. The right salpinx was as

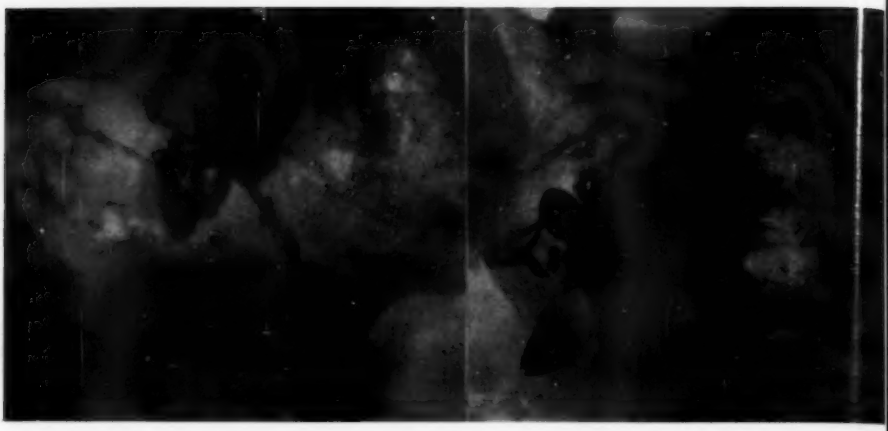


Fig. 1. Fig. 2.

before; the left resembled in its first part the earlier pictures, but the ampullar end now opened freely into the peritoneum, and the characteristic ovoid, net-like contrast design was no longer seen.

Case II. (Record no. 490/47.) — Married woman, 28 years old. Hitherto well. Menstruation since 15 years old, regularly. One childbirth, four abortions. Last menses, of normal strength and duration, four months before admission; since then irregular hemorrhages, in the beginning with passage of clots, later rather as splotchy bleedings. Now admitted to gynecologic service on account of pricking pains in the lower part of the abdomen. Subjectively, no symptoms of pregnancy; neither were any such found at objective examination. Gynecologic examination did not show any cyanosis. The uterus was large and soft, not markedly retroverted. Posteriorly to the right was felt a small, irregularly shaped, somewhat tender intumescence.

Hysterography (Fig. 3) showed a uterus of normal size, retroflexed and slightly bent towards the left. The left salpinx was normal, with free outflow into the peritoneum. The right salpinx was normal for a distance of a few centimeters, then it gradually widened to a diameter of 75 mm. There, an obstruction to the passage of the contrast fluid was seen, sharply defined but not complete, the fluid continuing as a thin linear tracing lateral to a formation, the size of a small apple, over which only a very small quantity of it had distributed itself rather like a veil. There was no sure sign of outflow into the peritoneum. The case was diagnosed as extrauterine pregnancy.

The operation confirmed the result of the hysterography. The ampullar portion of the salpinx was distended by an intumescence the size of a walnut-kernel. The abdominal ostium was rather wide. An incision was made over the projecting part, and the ovum, which adhered rather firmly to the wall of the tube, was evacuated without bleeding. The microscopy showed sequels of extrauterine pregnancy.

Case III. (Record no. 874/47.) — Married woman, 42 years old. Formerly well. Menstruation regular. Three childbirths, no abortions. In 1946 operated on (sin. salpingo-oophorectomy) for left-side extrauterine pregnancy. Last menses a month before

Fig. 3. Fig. 4.

admission to gynecologic service. Now admitted on account of splotchy hemorrhages and pain in the right side of the abdomen. No tendency to fainting. No subjective symptoms of pregnancy. Gynecologic examination showed normal conditions.

Hysterography (Fig. 4) showed a uterus of normal size, straight up and down. There was no filling of the stump of the left salpinx. The part of the right salpinx farthest towards the side was slightly distended, and the contrast fluid here formed an annular shadow around a fully hazelnut-sized filling, over which the fluid distributed itself as a thin net-like veil. There was copious outflow into the peritoneum. On the basis of these pictures, a diagnosis of suspected right-side extrauterine pregnancy was made.

The operation confirmed the hysterographic findings. The lateral part of the salpinx was for a distance of one-fourth of its length, 2 cm. from the abdominal ostium, distended to the diameter of one-half of the distal phalanx of a little finger. An incision was made, and a dark-coloured lump, the size of a hazelnut-kernel and resembling a coagulum, squeezed out. The microscopy showed tubal pregnancy.

SUMMARY

The author briefly mentions the principal characteristics of the hysterographic picture of extrauterine pregnancy and reports 3 typical cases.

ZUSAMMENFASSUNG

Verf. erwähnt kurz die wichtigsten Kennzeichen des hysterographischen Bildes bei Extrauterinschwangerschaft und berichtet über 3 typische Fälle.

RÉSUMÉ

L'auteur relève succinctement les principaux caractères de l'image hystérographique de la grossesse extra-utérine, et en rapporte trois cas typiques.

LITERATURE

1. Dyroff: Zbl. f. Gyn. *27:* 1798, 1928.
2. Friedman, S. L.: Am. J. of Obst. *35:* 683, 1937.
3. Grier, G. W.: Radiology: *14:* 571, 1930.
4. Hasselhorst, G.: Zbl. f. Gyn. *51:* 1821, 1927.
5. Kjellberg, S. R.: Acta Rad. Suppl. XLIII.
6. Magnusson, W.: Acta Rad. *26:* 265, 1945.
7. Mathieu, A.: J. A. M. A. *108:* 356, 1937.
8. Miller, H. & D. B. Martinez: Radiology *11:* 191, 1928
9. Nielsen, B.: Nord. Med. *31:* 2131, 1946.
10. —, Acta Rad. *28:* 185, 1947.
11. Schneider, P. & F. Eisler: Zbl. f. Gyn. *51:* 1360, 1927.
12. —, Fortschr. a. d. Geb. d. Röntgenstr. *37:* fasc. 2, 1927.

FROM THE ROENTGEN DIAGNOSTIC DEPARTMENT OF KAROLINSKA SJUKHUSET, STOCKHOLM, SWEDEN (CHIEF: PROF. ÅKE ÅKERLUND)

ON THE ROENTGEN ASPECT OF PROSTATIC CANCER BY URETHROCYSTOGRAPHY[1]

by

Nils P. G. Edling

Several authors have described the roentgen aspect of prostatic cancer on urethrograms in scattered cases (PUHL 1929, CRABTREE and BRODNEY 1933, KNUTSSON 1935, VINCENT 1935 and others). They have noticed a narrowing or an irregularity of the prostatic urethra but have claimed to be unable to indicate any differential diagnostic signs.

In a paper on urethrography MATHEY-CORNAT and DUVERGEY (1943) have compiled 42 cases of prostatic cancer, verified microscopically after operation. They point out, that one of the typical signs of prostatic hypertrophy, the sagittal dilatation of the urethral lumen (»lame de sabre») does not exist in cancer cases. The early cases (degré I) are only to be diagnosed by the micturition method, that shows a narrow and rigid lumen of the prostatic urethra, due to a lowered dilatability, while the injection method would give a normal picture. In more advanced cases the injection method is the most important. The authors find after the stadium of development the appearance of the urethra »tiré au cordeau», or »en lame d'urétrotome» (degré II), then unsharp to irregular contours (degré III) and finally destructive cavities (degré IV). The authors claim by these studies being able to diagnose prostatic cancer more early than with clinical methods. — KERR and GILLIES (1944) have shown that carcinoma of the prostate may cause narrowing of the lumen and often elongation of the prostatic urethra. The normal curve forward is usually lost and the urethra may be straightened or show abnormal curves and irregularities. If the base of the bladder is infiltrated the filling defect is irregular — a sign that also to ASSMANN, and SCHINZ-BAENSCH-FRIEDL, is characteristic of cancer.

Pathologically, depending on their mode of propagation, two main types of carcinoma prostatae are known, the first being a small pri-

[1] Submitted for publication, Dec. 30, 1947.

mary tumour with a marked tendency to early metastases, the second a massive local lesion but later metastases. In the first type, the tumour originating as a rule in the lower and posterior part of the prostate, one cannot expect a projection in the anterior portion of the prostate, where the urethra passes, and subsequently any change of the urethra in the urethrocystogram. However, an examination of the spine and pelvis may show osteoplastic metastases, indicating prostatic cancer, and confirm a clinical diagnosis. In the second type, being a more expansively growing form, it must sooner or later reach the urethra or its neighbourhood and affect its course, lumen width and length as well as the base of the bladder. Two signs are noteworthy. The cancer may grow in the posterior part of the prostate and reveal itself by rectal examination without any changes on urethroscopy or urethrocystography in the anteriorly situated urethra. Furthermore, the mucosa and submucosa of the urethra and bladder resist well to the carcinomatous growth. Ulcerations, as caused by primary bladder cancers are very seldom found. One may therefore find the contours of the urethra and bladder to be irregular but very seldom ragged on the urethrocystogram.

The carcinoma like the hypertrophy of the prostate occurs mainly past the age of 45. Thus, in certain cases they may be found simultaneously. According to BOYD hypertrophy is associated to cancer in about 50 % of the cases. In these cases the signs of hypertrophy may quite predominate on the urethrocystogram. If the cancer, however, has expanded to the prostatic urethra or grown into the adenomas interpretation will be more difficult. Deformation or displacement of the urethra caudally to the adenomas may be found, or deformation supracollicularly of a type that is unusual in benign hypertrophy and therefore may be recognized. In the uncomplicated cancer cases the location and growth of the tumour alone determines the changes on the roentgen picture.

In the enlargement of the prostate the urethra can only be elongated in a cranial direction, because the prostate is caudally in relation with the fascial covering of the urogenital diaphragm. When the infracollicular portion of the urethra is surrounded by only a small part of the prostate, the increase in size of the organ mainly includes the middle and upper parts (the collicular and supracollicular). The collicle itself is seldom increased in size. In practice, therefore, one can speak of a supracollicular enlargement even though the collicular relief is deformed or not visualized, and may not be outlined in the urethrocystogram. The total length of the prostatic urethra may not be exactly estimated, because it is not possible to make out roentgenologically the distinct demarcation of the inferior limit against the membranous portion.

In hypertrophy the adenomas grow expansively in a typical way. In most cases the urethrocystography shows the familiar supracollicular

elongation, and the smooth compression of the lumen from either side into a sagittal, sometimes tortuous ribbon shape; the angulation forwards; the deformation of the collicular relief; and the smooth protrusion into the base of the bladder. In pronounced cases the distortion of the lumen may be followed into the infracollicular portion. In some cases the only sign of hypertrophy may be a spherical bulging into the top part of the urethra or into the base of the bladder, caused by a »third prostatic lobe». The very location of the adenomatous enlargement explains that the expansion influences upon the urethral lumen from the beginning. The radiologist therefore has a clue to an early diagnosis.

In cancer the growth is atypical, usually originating in the posterior lobe. The enlargement is often asymmetrical with deformation of the lumen other than that produced by hypertrophy. As characteristic signs of prostatic cancer in the roentgen picture the earlier authors have also pointed out narrowing and irregularity of the urethral lumen, and an irregular protrusion into the base of the bladder.

The material upon which the author bases his study of the urethrocystogram in prostatic cancer consists of 68 urethrocystographies performed on patients with the clinical diagnosis cancer prostatae. This was verified by microscopical examination, after electroresection or removal in 59 cases and by signs of osseous metastases in 9 cases.

The patients fell into the following 10-year-age groups:

41—50 years	4	cases
51—60 »	10	»
61—70 »	28	»
71—80 »	21	»
81—90 »	5	»
Total number	68	cases

The youngest patient was 45, the oldest 86 years.

To help differential diagnosis the author has compiled comparative data on 68 urethrocystographies performed on patients with the diagnosis of hypertrophy, also verified microscopically after operation. The cases were examined consecutively in daily routine.

The age distribution divided into 10-year groups, are as follows:

41—50 years	3	cases
51—60 »	10	»
61—70 »	42	»
71—80 »	11	»
81—90 »	2	»
Total number	68	cases

The two youngest patients were 47, the oldest 82 years.

The ages of the patients in both series are in accord with the figures that are mentioned in the text-books of pathology.

The cases were examined by the technic that the author has described in 1945. Thus, the examination was performed as urethrocystography with simultaneous study of urethra and bladder. After anaesthesizing the urethra, one of the modern water-soluble contrast mediums was injected (most often abrodil or jodairal). The exposure was made during injection, after the bladder had begun to fill. The projections used were one or two frontal views, and right and left oblique views. In most cases the examination was completed by an attempt at a urethrocystography during voiding.

The materials have been analysed with regard to the different symptoms in the urethrocystograms of the prostatic urethra and the bladder.

Elongation of the prostatic urethra. 58 of the 68 cases of cancer showed this sign, and in most of them the elongation mainly involved the supracollicular portion (Figs. 2, 3, 4). In the remaining 10 cases elongation was not evident roentgenologically. In 4 of these last cases, on the other hand, there was an increase in size of the posterior part of the prostate on rectal examination.

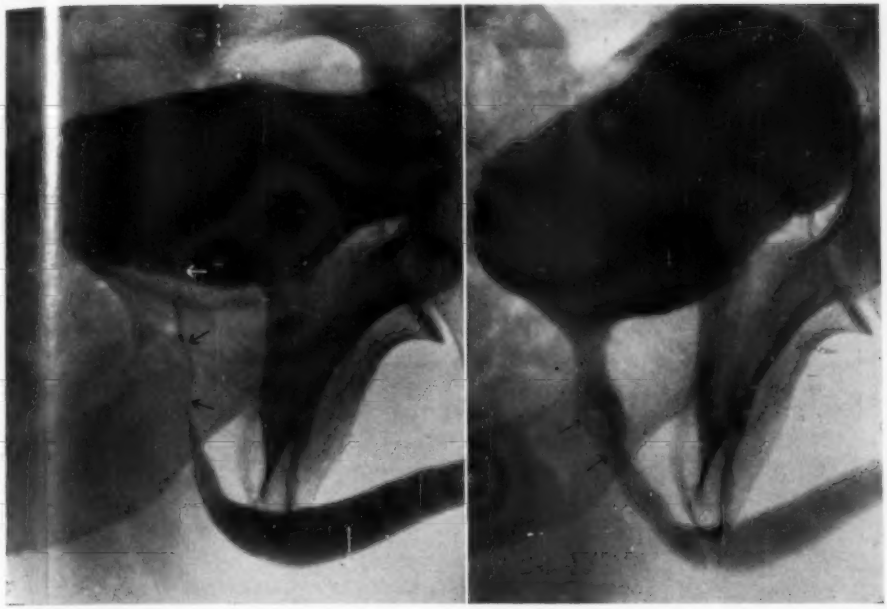
In 66 of the 68 cases of hypertrophy, the prostatic urethra was elongated, mainly supracollicularly, and in 2 cases had a normal length. As in cancer, occasional cases revealed an elongation of the whole prostatic urethra.

The elongation of the prostatic urethra is an important sign of enlargement of the organ but it is not characteristic per se. Even though it would involve the larger part of the prostatic urethra it is not alone a sign of cancer. The author has already in his thesis pointed out that a pronounced hypertrophy may interest the infracollicular portion. It is important, too, that the urethrocystography may show a urethra of normal length, that is a prostate anteriorly unchanged, while the findings per rectum indicate an enlargement of the posterior lobe. Other cases in the cancer material also show that the urethra may be of normal length without rejecting the clinical diagnosis.

Luminal width. In 42 of the cancer cases the lumen was narrowed: mainly supracollicularly in 36 of these (Figs. 2, 3), and along the whole prostatic urethra in 6 cases (Fig. 4). In the remaining 26 cases the lumen was more or less flattened of hypertrophic type.

65 of the hypertrophy cases showed this compressed ribbon shape, in one case through the whole prostatic urethra. In the 3 remaining cases this sign was absent and the lumen had normal width.

We know that the prostatic urethra normally is contracted due to the sphincter tonus, and in urethrocystography shows a narrow lumen



Injection Micturition

Fig. 1. Normal case. Injection and micturition pictures in exactly the same oblique view. During injection contracted prostatic urethra with smooth contours and fine collicular relief. The internal urethral orifice plainly visible. During micturition (against resistance) widening of the lumen of the prostatic urethra, change in shape of the bladder and sinking of the pelvic floor.

(Fig. 1). In the normal urethrocystogram the luminal contours are smooth, only interrupted by the distinct collicular relief. On the contrary the cancer cases often show a deformed lumen and collicular relief. The narrowing of the urethra in cancer is caused by the constricting growth of the cancer masses. The flattening of the urethral lumen in 26 cases of the cancer material is explained by accompanied hypertrophy, causing a more or less definite ribbon aspect.

Deformation of the lumen. In 63 of the cancer cases there was a deformation of the lumen, and in as many cases the collicular region was also deformed. 16 of these cases had quite irregular contours (Figs. 3, 4). In 12 cases there was an abrupt bayonette type deformation due to impression with a distinct kink of the luminar course (Fig. 6). Moreover, the deformation was an asymmetry due to less marked impression, any-

Fig. 2. Fig. 3. Fig. 4.

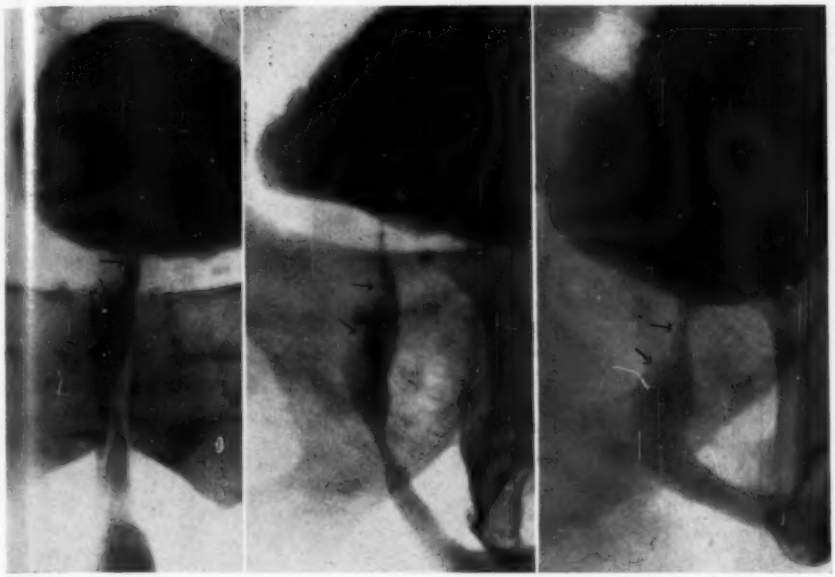
Fig. 2. Prostatic cancer (el. resect. and micr. exam.). Elongated and proximally narrowed prostatic urethra with very slight irregularity of the contours. No collicular relief visible.

Fig. 3. Prostatic cancer (el. resect. and micr. exam.). Straight course of prostatic urethra that is elongated and narrowed supracollicularly with irregular contours. The collicular relief not visible. Irregular bulging into the bladder base.

Fig. 4. Prostatic cancer (el. resect. and micr. exam.). Straight course of prostatic urethra that is elongated and narrowed with more irregular contours than in Fig. 3 in its whole length. Small bulging into the bladder base.

where within the prostatic urethra, most often supracollicularly (Figs. 5, 10). The remaining 5 cases had no such deformation.

In addition to the ribbon deformation 15 of the hypertrophy cases revealed a deformation of the lumen. One of them had a quite irregular flattening of the lumen, and 4 cases a slightly uneven ribbon deformation. In the first case the microscopical examination revealed fibro-adenomatosis with atypical cells. 5 cases had fairly marked asymmetric impressions into the ribbon shaped lumen. The 5 last cases showed proximally in urethra deformation due to spherical adenomas of the »third lobe» type. The collicular region was deformed in 59 of the hypertrophy cases.



Injection. Injection. Micturition.

Fig. 5. Prostatic cancer (el. resect. and micr. exam.). Bulging from right and behind into the upper part of the prostatic urethra that in the remaining part is deformed as in hypertrophy. No collicular relief visible. Reduced dilatability of urethral orifice and upper part of the urethra during micturition. Trabeculation of the bladder wall.

Thus, irregular contours and abrupt asymmetric impressions within the prostatic urethra are signs that appear almost exclusively in cancer, as opposed to hypertrophy. Marked irregularities of the lumen may also often be seen after removals and electroresections. Where complete resection was performed, the visualisation of the postoperative cavity is an important differential diagnostic factor while incomplete interventions may lead to a false cancer diagnosis in absence of accurate anamnesis. The asymmetric impressions less pronounced are much more often seen in cancer patients than in hypertrophy patients. A unilateral impression appearing anywhere within the urethra is therefore noteworthy. It gains in importance if, in addition, the lumen is narrowed or irregular. The adenomatous bulging of the »third lobe» type is characteristized by its spherical smoothness and relationship to the internal urethral opening.

The deformation of the collicular relief is quite usual both in cancer and hypertrophy, and is not of a differential diagnostic value. One ought

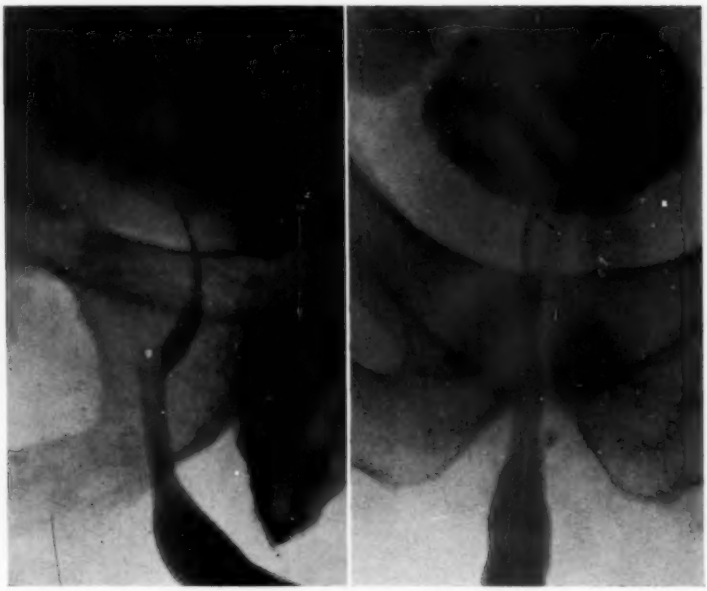


Fig. 6. Fig. 7.

Fig. 6. Prostatic cancer (el. resect. and micr. exam.). Abrupt, bayonetlike deviation due to a large protrusion from right and behind into the supracollicular urethra narrowing the lumen. No collicular relief visible. Mild and smooth bulging into the bladder base.

Fig. 7. Prostatic cancer (el. resect. and micr. exam.). Displacement of the prostatic urethra to the right due to protrusion from left. In addition, trabeculation and diverticulum of the bladder indicating chronic obstacle to the outflow from the bladder.

to observe specially such cases where the collicular relief seems to be larger than normal and has asymmetric form or is faintly outlined.

Angulation. In 45 of the cancer cases there was an anterior angulation of the supracollicular part of the urethra; in some of these cases it was quite marked. In the remaining 23 cases the prostatic urethra had a slightly curved or straightened course (Figs. 2, 3, 4).

There was angulation in 64 cases of the hypertrophy series, the appearance being that generally described as characteristic of hypertrophy.

The angulation can in both cancer and hypertrophy deviate anteriorly, or anteriorly and laterally. The cancer showed the most pronounced deviations, which is expected because of its more intensive growth. In some of the cancer cases the angulation might be explained

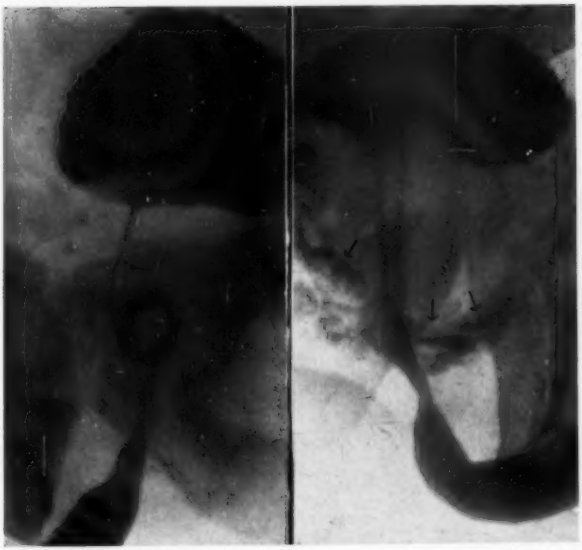


Fig. 8. Fig. 9.

Fig. 8. Prostatic cancer (hard prostate, osteoplastic metastases in spinal column and pelvis). Displacement of the entire prostatic urethra forwards and to the right.

Fig. 9. Pronounced prostatic hypertrophy (el. resect. and micr. exam.). Contrast filling of ducts and glands in the glandular part itself which is displaced caudally.

by the accompanying hypertrophy. While a moderate angulation in the most cases indicates more hypertrophy than cancer, it is not true of a straightened urethra, especially if the lumen is simultaneously elongated, narrowed or irregular (Figs. 3, 4). These figures show aspects that are not found in the hypertrophy series.

Displacement of the entire prostatic urethra. In the cancer cases a lateral displacement of the whole prostatic urethra could be seen in the frontal view in 30 cases (Fig. 7). 12 of these cases showed also an anterior displacement even infracollicularly, in oblique view (Fig. 8). 8 further cases had an abrupt lateral bayonette-type kink of the luminal course supracollicularly. (Cf. Fig. 6.)

In the hypertrophy material there was no case showing evident displacement of the entire prostatic urethra. In 25 cases a lateral deviation of moderate degree, in connection with the supracollicular angulation could be seen.

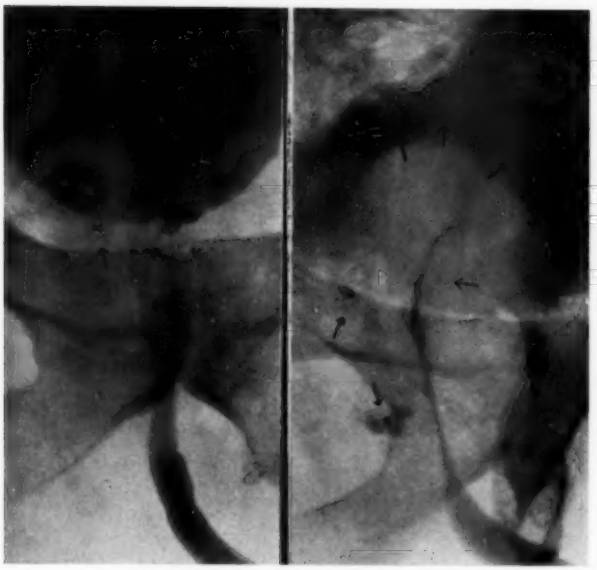


Fig. 10. Fig. 11.

Fig. 10. Prostatic cancer (el. resect. and micr. exam.). The lower part of prostatic urethra is bowed and displaced to the right. At the same level some calcifications of the right part of prostate are forced upwards. Deformity of the upper part of prostatic urethra.

Fig. 11. Prostatic cancer (firm nodular finding, especially to the right, on rectal exam.). Elongated, and supracollicularly flattened and angulated prostatic urethra. The flattening is interrupted in the lower part. In the base of the bladder a slightly irregular protrusion. To the right two groups of calcifications, one forced upwards, the other downwards, by expanding masses from the posterior part of the prostate. Trabeculation.

It is of interest to compare these findings in the present materials with the same aspects of the normal and pathological cases in the authors thesis' material. In 14 normal cases, examined in frontal view, the prostatic urethra did not in any case deviate from the course in the sagittal plane. In 204 pathological cases, consisting of patients with hypertrophy, cancer, prostatitis, stricture etc. there were 8 with lateral displacement of the whole prostatic urethra. Only one case could not be accounted for; 4 cases were explained by cancer, 2 by removal or electroresection and one by rupture of urethra after a severe trauma.

A survey of these findings shows that a lateral displacement of the entire prostatic urethra almost exclusively appears in prostatic cancer.

The presence of this sign in urethrocystography indicates therefore malignancy. It is of great importance as a lateral displacement is more often easier to recognize in frontal view in supine position, than displacement in other directions in oblique views.

Protrusion into the base of the bladder. In the cancer material there was a bulging with irregular contours into the bladder in 25 cases (Fig. 3), and with smooth contours as in hypertrophy in 36 cases. No bulging could be seen in the remaining 7 cases.

The hypertrophy patients revealed in 60 cases a smooth bulging into the bladder, and in 7 cases a spherical adenoma at the internal urethral orifice. In the remaining case there was no alteration of the bladder base.

The material shows consistently that only cancer caused irregular contours in the base of the bladder. In all cases where the hypertrophy expanded into the bladder the contours were quite smooth.

Dilatability. In 54 cancer cases an examination attempted during micturition was made. Of these, 20 were successful in making it possible to study the dilatability of the posterior urethra. In 16 cases it was more or less decreased (Fig. 5), in 4 good. In the latter cases the urethra dilated without deformation in one case, and with impression in the 3 remaining.

In 62 hypertrophy cases the attempt at examination during micturition was made. The dilatability could be determined in 13 cases. In 4 of these it was more or less decreased, in the remaining 9 cases good in spite of deformation by bulging adenomas in 4 of them.

The attempts at micturition were performed in daily routine by different physicians. The number of the successful cases would probably have been larger if one person could have performed all the examinations under quiet conditions. The materials indicate that the cancer patients were able to void in front of the roentgen tube more often than the hypertrophy patients, although the dilatability was often considerably decreased.

The 4 cancer cases with good dilatability showed distinct signs of malignancy by the injection method. This fact shows that MATHEY-CORNAT's and DUVERGEY's statement that the decreased dilatability is an early sign of prostatic cancer, has not a universal value.

Trabeculae and diverticula of the bladder wall. In the cancer material there were roentgenological signs of long-standing obstacle to the evacuation of the bladder in 49 of the 68 patients. In 28 cases there was only trabeculation (Fig. 5), in 17 cases trabeculation + diverticula (Fig. 7), and in 4 cases only diverticula.

In 50 cases of the hypertrophy material only trabeculation appeared in 4 cases, and trabeculation + diverticula in 16 cases.

Thus, the roentgenological signs of obstacle to the emptying of the bladder, appeared in about as many cases in the two materials. The changes of the wall, however, was considerably more pronounced in the hypertrophy cases. Of these, 27 had a pronounced or fairly pronounced trabeculation and diverticular formation, but this was seen in only 4 of the cancer patients. Moreover, the lesser degrees of these wall changes in the remaining cases were also more evident in hypertrophy. The explanation surely is that the obstacle to the outflow from the bladder has less often the possibility to be so long continued in cancer patients, even when hypertrophy and cancer appear simultaneously.

Calcifications and cavities within the prostate. Among the cancer cases 9 had calcifications, and 6 showed contrast filling of cavities and ducts within the prostate. Calcifications as well as cavities were observed in 4 additional cases.

In 5 cases of the hypertrophy series there were calcifications, and in 19 cases injected cavities or ducts. In 2 further cases one saw both calcifications and ducts. In 4 cases showing contrast filled ducts the glandular tissue itself was displaced in caudal direction by the above hypertrophic adenomas.

It is necessary to study particularly the position and size of the calcifications on the plain radiogram before the urethrocystography. Otherwise it can be difficult to determine if a contrast filling within the prostate has or not appeared during the contrast examination. The plain radiogram is also important to expose numerous and widespread calcifications, which hardness may simulate cancer on rectal examination.

In the cancer as well as the hypertrophy cases the cavities and ducts had the appearance seen in postinflammatory changes. The type was the same in the both materials, and one group had nothing characteristic in comparison to the other.

With help of the displaced calcifications, and cavities and ducts it can be roentgenologically shown that the hypertrophic masses may force the glandular tissue itself in caudal direction. Fig. 9 points out on the roentgenogram a good view of the pressure atrophy of the tissue between the contrast filled ducts, and the glandular tissue itself encasing the lower parts of the hypertrophic masses. There were no cancer cases with evident displacement of calcifications or ducts in cranial direction in the material. Sometimes such cases appear in the routine examination where it is possible to show that the glandular tissue is forced in cranial direction by tumour masses expanding from the posterior lobe. (Figs. 10, 11).

This study of cancer and hypertrophy materials indicates that prostatic cancer may cause urethrocystographic changes, of different nature or degree than hypertrophy. The important signs to observe in the roent-

gen picture are a narrowed and irregularly deformed lumen, abrupt kink of the luminal course, displacement laterally or anteriorly of the entire prostatic urethra, and irregular bulgings into the base of the bladder. The elongation of the prostatic urethra is in both cases only a sign of enlargement of the organ. However, the more signs that appear simultaneous with the enlargement the more accurately the cancer may be diagnosed. Yet it is important to note that the urethrocystogram may not show the characteristic signs although the clinical findings indicate cancer because of hardness and enlargement posterior. It is especially important to note also that the roentgen picture of associated cancer and hypertrophy of the prostate may show predominance of the signs of hypertrophy. In such cases the cancer may be masked and can not be discovered on the urethrocystogram.

SUMMARY

The paper is a study of the urethrocystograms in 68 cases of prostatic cancer as compared with as many cases of prostatic hypertrophy. An elongation of the prostatic urethra combined with a narrow and irregular lumen, abrupt kink of the luminal course, displacement laterally or anteriorly of the entire prostatic urethra, and irregular bulgings into the base of the bladder, may constitute a characteristic cancer picture. The absence of these signs, however, does not eliminate clinically suspicious cancer.

ZUSAMMENFASSUNG

Die Arbeit enthält eine Gegenüberstellung des urethrozystographischen Bildes von 68 Fällen mit sicherem Prostatakrebs und ebensovielen Fällen mikroskopisch bestätigter Hypertrophia prostatae. Verlängerung der prostatischen Urethra verbunden mit schmaler und unregelmässiger Lichtung, Verlagerung der gesamten prostatischen Urethra nach einer Seite oder nach vorwärts sowie unregelmässige Einbuchtungen des Blasenbodens können ein charakteristisches Krebsbild darstellen. Das Fehlen dieser Symptome ist jedoch kein Beweis gegen einen klinischen Krebsverdacht.

RÉSUMÉ

Cet article constitue une étude comparative de 68 cas de cancer de la prostate et d'un nombre égal d'hypertrophies. Un allongement de l'urètre prostatique associé à un rétrécissement et à des irrégularités de la lumière urétrale, une coudure au cours du trajet normal, un déplacement latéral ou antérieur de l'urètre prostatique en bloc, ainsi que des empreintes irrégulières à la base de la vessie, constituent les éléments principaux du tableau radiologique du cancer de la prostate. L'absence de ces signes n'élimine cependant pas tout soupçon cliniquement fondé d'un cancer.

BIBLIOGRAPHY

ASSMANN, H., Die klinische Röntgendiagnostik der inneren Erkrankungen. Berlin 1934.
CRABTREE, G. & BRODNEY, L., An estimate of the value of urethrogram and cystogram in the diagnosis of prostatic obstruction, J. Urol. 29: 675, 1933.
EDLING, N. P. G., Urethrocystography in the male with special regard to micturition, Acta radiol., suppl. 58, 1945.
KERR, H. D. & GILLIES, C. L., The urinary tract. Chicago 1944.
KNUTSSON, F., Urethrography, Acta radiol., suppl. 28, 1935.
MATHEY-CORNAT, R. & DUVERGEY, H., Sur l'exploration uréthrographique des cancers de la prostate, J. de radiol. et d'électrol. 25: 199, 1942—43.
SCHINZ-BAENSCH-FRIEDL, Lehrbuch der Röntgendiagnostik. Leipzig 1939.
VINCENT, P. G. A., L'urétrographie par voie mictionelle. Paris 1935.

ROM THE RADIUM CENTER, COPENHAGEN, DENMARK (CHIEF: JENS NIELSEN, M. D.)

THE PROGNOSTIC SIGNIFICANCE OF EARLY DIAGNOSIS IN BREAST CANCER[1]

A Study of the early Symptoms and their Duration before the Patients come under Treatment

by

Sigvard Kaae

In the treatment of breast cancer, as in the treatment of all other types of cancer, it is of paramount importance for the result that adequate therapy be instituted as early as possible. The present study is an attempt to examine how long time usually elapses from the moment when the first symptoms manifest themselves until the patient comes under proper treatment, the reasons why the patients in many cases come under treatment rather late, and what may be done to get them under treatment as early as possible.

Literature

The first symptom the patient notices is usually a lump in the breast; therefore, this is the most important of the symptoms that cause a woman to seek medical advice. KUNATH found such a lump to have been the first symptom in 84 per cent of cases, EGGERS, CHOLNOKY & JESSUP in 77 per cent.

In the early stages, cancer of the breast is not a painful disease. Statements respecting the incidence of pain as an early symptom — taking pain in the widest sense, as meaning all subjective sensations localised to the breast — are greatly at variance. CHEATLE specially notes that when the patients are questioned closely they will often state that the first symptom was a pricking, lancinating pain in the breast, which drew their attention to it and resulted in their discovering the nodule. EGGERS, CHOLNOKY & JESSUP found pain as the first symptom in 4.3 per cent of cases, KUNATH in 8 per cent; BEHAN reports it in 11.8 per cent,

Submitted for publication, Dec. 14, 1947.

and VERHAVE found localised itching in 4 per cent. WEVIL found pain as symptom in about two-thirds of his patients. In 15 per cent of these, whose statements were sufficiently precise to be relied upon, the pain had been present long before the tumor was noticed, while in 25 per cent its onset was synchronous with the finding of the latter; the pain being, as a rule, the first symptom which drew attention to the breast and led to the discovery of the nodule.

Discharge from the nipple as first symptom was found by KUNATH in 13.3 per cent of cases; in 4 per cent of these it was sanguineous. EGGERS, CHOLNOKY & JESSUP found bleeding from the nipple as first symptom in 2.1 per cent of cases, while in 5.4 per cent ulceration, in 4.3 per cent deformity of the breast were the first manifestations of the cancer.

The average length of time from the discovery of the tumor until the patients came under treatment was in a series of cases studied by DAHL-IVERSEN (1927) 9.5 months, in 1,000 cases studied by WEVIL (1932) 14.74 months, in a series of cases recently analysed by ANDREASSEN (1947) 3 months. NATHANSON & WELCH (1936) found that the average duration of symptoms of 575 cases was 1,05 years. GESCHICKTER (1943) separates in his own cases the infiltrating from the circumscribed forms, and finds that for the more circumscribed, slowly growing cancers the average duration of symptoms is 17.5 months, for the more rapidly growing, infiltrating tumors 10.0 months. Of the cases in HARRINGTON's material from 1910 to 1939, 47.5 per cent came under treatment within 6 months, 65.1 per cent within a year after the first manifestation of the symptoms. The duration of the symptoms before the cases came to operation became steadily shorter from 1910 to 1939. Thus, during the period 1910—1914 only 32.6 per cent were operated upon within 6 months, as against 56.4 per cent in 1935 to 1939, and in 1910—1914 only 54.3 per cent within a year as against 70.4 per cent in 1935 to 1939. HAAGENSEN & STOUT found that 17 per cent came under treatment within a month after the tumor had been discovered, 57 per cent within 6 months, 77 per cent within a year.

The duration of the symptoms as a factor in the prognosis is estimated very differently. NATHANSON & WELCH found that patients with the shortest delay in treatment had the worst prognosis, LEWIS & RIEFENHOFF, KUNATH and WEVIL did not find any marked difference. MACDONALD found that the cases which came to operation with least delay had the best prognosis, especially those which were operated upon not later than two months after the tumor had been discovered. HOOPES & MCGRAW found the same to be the case when they divided the cases into two groups, with and without axillary lymph node metastases, and considered each group separately. EGGERS, CHOLNOKY & JESSUP found a fall in five-year survival percentage following operation, from 76 per cent

for cases operated on within 1 month to 20 per cent for the cases which did not come to operation until after 1 to 2 years; after which there was an increase in the percentage of recoveries to 40.9 per cent for the cases in which operation was delayed 3 years or more. GESCHICKTER found an unfavourable effect of delay, when he considered the more circumscribed, slowly growing tumors and the more rapidly growing, infiltrating forms separately, particularly pronounced for the last-named group.

The probable explanation of the fact that the prognosis does not always get worse with increasing duration of the symptoms is that the more rapidly growing and early metastasising tumors come under treatment sooner and yet have a poorer prognosis. Besides, the figures in all these analyses relate only to cases operated on, while no account has been taken of the inoperable cases, whose numbers must be supposed to have increased the longer the symptoms have been present before they came under treatment.

The earlier the patients come under treatment, the smaller are the tumors (HAAGENSEN & STOUT). It is generally recognised that the size of the tumor is a very important factor in the prognosis, and that the latter is much more favourable for the small tumors than for the large (HAAGENSEN & STOUT; EGGERS, CHOLNOKY & JESSUP; DAHL-IVERSEN). Thus, HAAGENSEN & STOUT found that for tumors less than 30 mm. in diameter the five years' freedom from symptoms after operation was 62.2 per cent, for tumors between 30 and 59 mm. 43.0 per cent, for tumors 60 mm. or more 19.4 per cent.

It is also generally recognised that the presence of microscopically demonstrable axillary lymph node metastases have a determining influence on the prognosis after radical mastectomy. Thus, PACK & LIVINGSTON found that of cases with histologically demonstrable metastases in the axillary nodes 22 per cent had five years' freedom from symptoms, of those in which there was no axillary involvement 70 per cent. The incidence of axillary metastases was by HOOPES & MCGRAW found to be with less than 1 month's duration of the symptoms 55.3 per cent, with from 1 to 6 months' duration 59.8 per cent, with over 6 months' duration 62.7 per cent. The increase is not very marked; probably because the more malignant, more rapidly growing and earlier metastasising tumors come under treatment earlier than the less malignant and slower growing types. HAAGENSEN & STOUT also found progressive axillary involvement with increasing size of the tumor; but even with tumors less than 20 mm. in diameter they found such involvement in 43.8 per cent of cases; which shows that even small tumors often have axillary metastasis.

All authors agree on the importance of trying to get the patients to consult a physician at the first discovery of a lump in the breast. CHEATLE

points out that medical advice should be sought in all cases where there is either a local nodosity, local lancinating pain or discharge of blood or serum from the nipple. AUCHINLOSS thinks that all girls of twenty should be taught to palpate the breast tissue, at intervals, for a lump, because a woman will often be able to feel a small nodule which the physician does not notice until his attention has been called to it. EGGERS, CHOLNOKY & JESSUP, among others, stress that when a patient presents herself with a lump in the breast it is the physician's duty to refer her at once to a surgeon. In a large percentage of cases, a clinical diagnosis is possible with reasonable certainty. In all doubtful cases, and this applies particularly to the early, favourable ones, a biopsy should be suggested.

Author's Material

The present study is based on a material from the Radium Center in Copenhagen from the period June 1944—December 1946. I have personally questioned all the patients in order to get the anamnestic data as full and correct as possible, because I have found that the information obtained from the usual record entries made by shifting assistant physicians without special interest in the subject are very often incomplete, or even directly misleading.

The material comprises, in all, 500 patients with either carcinoma of the breast or Paget's disease of the nipple. All new cases are included, but not cases which have been referred to us for recurrence or metastases after having been treated elsewhere. Forty-three of the patients had been radically operated on in some other hospital and were referred to us for postoperative roentgen treatment; the others had either not been treated at all, or biopsy or local extirpation of the tumor had been made.

The diagnosis of cancer or Paget's disease has been verified histologically in all cases except one — a case of large, inoperable, clinically certain cancer, whose subsequent course with metastases and eventual lethal issue confirmed the diagnosis.

Surgical hospital services usually receive a larger percentage of operable, and a smaller percentage of inoperable breast cancer cases than it would be expected considering the distribution actually found when the diagnosis is established and the patients come under treatment; because a large percentage of the inoperable cases are treated radiologically outside the surgical services — either as bed cases or ambulantly in radiologic services. At the Radium Center, on the other hand, one would rather expect to find a larger percentage of inoperable cases, because that institution, besides a normal proportion of breast cancer cases, receives for radiologic treatment a number of inoperable cases from physicians who usually send their operable cases to other hospitals. In

Table I

The material grouped according to how it was referred to the Radium Center

	No. of cases	Technically operable		Radically operated upon	
		No. of cases	Per cent	No. of cases	Per cent
I Referred as inoperable	10	4	40	1	10
II Non-selected, from districts served by provincial Hospitals and from the surgical policlinic of the Municipal Hospital, Copenhagen	93	81	87	74	80
III. Non-selected, from practising physicians.....	205	181	88	160	78
IV. Others.....	192	160	83	128	67
Total	500	426	85	363	73

order to find out, if possible, to what extent the patient material of the Radium Center, as referred to us, is a selected one (no case of breast cancer has been refused), I have divided the cases into four groups (Table I). Group I comprises the cases referred to us from hospitals or surgeons who send us only their inoperable cases. Group II comprises cases from certain areas served by provincial hospitals which send practically all their breast cancer cases to the Radium Center in Copenhagen. In these counties there are no radiologic services, and the operable cases were either sent to us for pre- or postoperative roentgen treatment or were referred to us directly from the practising physicians. The group further comprises cases from the surgical policlinic of the Municipal Hospital in Copenhagen, which has referred nearly all cases of breast cancer to the Radium Center. Group III comprises cases from the whole of Copenhagen with outlying districts (»Greater Copenhagen»), referred by physicians who seem to have sent all their cases of breast cancer to the Radium Center. Group IV comprises the rest of the cases, and as regards this group it is not possible to say whether we have to do with a selected material or not. Presuming groups II and III to be non-selected, we get 12 per cent of technically inoperable, which for 500 cases would give 60, in all. But there are 74, *i. e.* 14 too many (of which 6 in group I). If we in the same way examine the number of radically operated, we should from groups II + III expect about 79 per cent, which for 500 cases would give 393; but there are only 363, or 30 less than expected (of which 9 in group I). From this, it seems that there has only to a very small extent been any question of selection in the way of technically inoperable cases or cases which for some reason or other (biological inoperability or refusal of operation) are not being

Table II

Age distribution in author's material and in the material of the Danish Cancer Registry from 1942

Age	<30	30—39	40—49	50—59	60—69	≥70
Author's material.....	0.4 %	7.2 %	22.4 %	25.4 %	27.6 %	17.0 %
Cancer Registry's material	0.70%	9.97%	27.92%	24.03%	25.23%	12.21 %

operated upon. If we compare the age distribution of the material with the distribution in the Danish Cancer Registry's material of breast cancer cases reported in 1942 (OLUF JACOBSEN), we find it to be about the same (Table II), though with a slight shift towards the older age classes for the material of the Radium Center, as it was to be expected if it included a larger percentage of cases which on account of the patient's age were not treated surgically. As the difference is rather slight, the material may also from this point of view be considered as only to a very little extent selected.

Of the 500 patients, 5 were males with carcinoma of the breast, the others were females: 2 with sarcoma of the breast, 17 with Paget's disease of the nipple (with or without demonstrated cancer), 476 with carcinoma of the breast without Paget's disease. One woman of the last group had had her tumor for forty-six years, and as it is not likely that it had been malignant all the time and it could not be determined when it had become so, her case is not included in the following analysis.

Mammary Carcinoma in Women, without coincident Paget's Disease

First Symptoms. — Table III shows the frequency with which each of the different symptoms was present as the first manifestation of cancer. In most of the cases, by far, namely in 74 per cent, the first sign was a nodosity in the breast (herein included the cases in which the feeling on palpation was that of a thickening or induration of the mammary tissue); in 87 per cent of the cases the condition was observed by the patient before the first medical examination. Next in frequency (12 per cent) were painful sensations in the breast, the axilla or radiating out into the arm, nearly always slight and more or less indefinite, in the form of tenderness, pricking, spasmodic tics, itching or smarting. Only in one case was there a strong, lancinating pain in the breast. In 57 of the cases, these sensations had been present before the tumor was noticed, in 27 of them (*i. e.* 6 per cent of the 475) they had drawn the patient's attention to the breast, with the result that the tumor was discovered a few days afterwards. In 14 cases, between a week and a month had elapsed before

Table III

Manifestation of first symptom and of the different symptoms before observation of the mammary tumor

	First symptom		Manifestation before observation of the mammary tumor	
	No. of cases	Per cent	No. of cases	Per cent
Mammary tumor	353	74		
Sensations in breast, axilla or out in the arm	56	12	57	12
Retraction of nipple	20	4.2	23	4.8
Discharge from nipple	13	2.7	14	2.9
Axillary lymph node tumor	12	2.5	19	4.0
Ulceration in breast	8	1.7	9	1.9
Diverse	9	1.9	11	2.3
No symptoms	4	0.8		
Total	475	99.8		

the tumor was observed, in the rest from over a month to a couple of years. Here are not included the cases in which a relation might be found between the menstruation and the sensations, or in which the patients had had the same sensations since they were young. In 6 cases, these symptoms alone had caused the patients to consult a physician, who then discovered the tumor.

Retraction of the nipple had been the first symptom in 20 cases (4.2 per cent). In 11 of these, it became the cause of the patient noticing the presence of a tumor a few days later; in the others from one to nine months elapsed before the tumor was discovered.

Discharge from a non-ulcerated nipple was the first symptom in 13 cases, and was in 14 cases present before the tumor was observed. In 2 cases, the fluid discharged was clear and yellowish, in 1 case white, in the remaining sanguineous or alternatingly yellowish clear and tinged with blood. In 6 of the cases, the tumor was observed within two months, in 5 cases not until over a year after the discharge had first been noticed. In 1 case, the patient consulted a physician on account of bloody discharge of ten days' duration, with the result that the physician discovered the tumor.

Axillary lymph node tumor was the first symptom in 12 cases, and was observed prior to the discovery of the breast in 19. In 2 of the cases in which radical operation was performed, there were no histologically demonstrable metastases in the nodes that at palpation had been felt enlarged.

In 9 cases, the patient had become aware of ulceration in the breast without having previously noticed the underlying tumor. In 2 cases

the first sign had been pain from metastases in the spinal column, while in 7 cases the first signs had been respectively supraclavicular metastases, pain from metastasis in the small pelvis, shrinking, redness or retraction of the skin above the subsequently observed tumor, cutaneous extension of neoplastic tissue beyond the region of the breast, and an enlargement, not formerly present, of the latter. In 4 cases, the tumor was found at medical examination for some other complaint, without the patient having observed any symptoms referable to the breast.

Anamnesis prior to first medical Examination. — Table IV shows the length of the delay between the patients' observation of the first signs and the first medical examination. One-third of them consulted a physician within a week, about one-half (48 per cent) within a month, about two-thirds (65 per cent) within three months, 77 per cent within six months. The Table further shows that the patients under fifty years of age sought a physician earlier than those above that age; thus, of the former, 40 per cent did so within a week, of the latter only 30 per cent. Precisely the same is the case as regards the delay between the discovery of the mammary tumor and the first medical examination, though, of course, with a larger percentage of early consultations; thus, 36 per cent within a week, 52 per cent within a month.

In order to find out why the patients did not seek medical advice on the first appearance of the symptoms, I have inquired into the causes with regard to the 199 patients who did not consult a physician until over a month after they discovered the tumor in the breast. Fifty-nine per cent of them said that they had simply not attached any importance to the presence of the nodule, 31 per cent had delayed from fear of an operation or because they dreaded to be told that they had cancer, 6 per cent »had not had time to be sent to a hospital and be operated on» (either

Table IV

Length of delay between onset of symptom and medical consultation in carcinoma of the breast in women

Age at observation of first symptom (years)	1 Week or less	1 Month or less	3 Months or less	6 Months or less	12 Months or less	Total No. of cases
	Per cent	Per cent	Per cent	Per cent	Per cent	
< 40	40	60	67	82	91	45
40—49	39	54	70	82	92	109
50—59	27	45	67	76	85	129
60—69	30	45	61	75	86	118
≧ 70	35	45	61	74	85	74
All ages	33	48	65	77	87	475

because they had sick relatives at home or for economical reasons); the remaining 4 per cent gave diverse reasons of less interest; thus, one of them thought that uncooked food was better, because she had seen poor results of operation among her relatives. Of 92 patients who had not consulted a physician until over six months after they had discovered the tumor, 48 per cent had not considered it of sufficient importance, 47 per cent had dreaded the thought of an operation. Of the 475 patients in this material, there were thus 44 who had been aware of the presence of their tumor for over six months without attaching any importance to it. Seven patients who had noticed a swelling of their axillary lymph nodes before they discovered the tumor in the breast had waited over a month before seeking medical advice. None of these had attached any importance to the enlarged lymph nodes, because »one so easily gets swollen glands in the armpit.»

What finally had made the 199 patients who had delayed for over a month seek medical advice was in 38 per cent of the cases that the swelling had persisted and grown larger, in 13 per cent pain in the breast, axilla or out into the arm, in 12 per cent ulceration, in 6 per cent symptoms from distant metastases, in 4 per cent extension to the skin or cutaneous metastases. Fifteen per cent had come to the physician on account of some other complaint and had then either incidentally shown him the lump in the breast, or the physician had himself discovered it; the remaining 12 per cent had come for various other reasons. Thus, 35 per cent of these patients, or 15 per cent of the total material of 475, had not sought medical advice until caused to do so by pain, ulceration, involvement of the skin or distant metastases. Of the 61 who had put off seeking medical advice for over a month after noticing the tumor, for fear of operation or of being told that they had cancer, 28 per cent had only gone to doctor because ulceration had set in, and oftenest on account of intolerable stench or stronger bleeding from the latter. Four per cent had been prompted to come by hearing lectures or reading articles in the papers, about breast cancer. Radio-talks and newspaper articles had indeed been the direct means of bringing 10 of the 475 patients to consult a physician. Certainly not a great number, but indirectly the whole educational campaign conducted through these and other channels for the control of breast cancer has no doubt been of great importance in a much larger number of cases.

In order to examine the significance of the social conditions, I have divided the material in three groups: 1) patients who had gone to the chief-physicians in their private consultation, 2) other patients who paid their doctor's fees themselves, and 3) the rest (members of sick-benefit associations, etc.). There was no positive difference. For instance, of the three groups respectively 48, 50 and 50 per cent had consulted the physi-

cian within a month after the first manifestation of the symptoms. Neither did the question of single or married state seem to make any marked difference; thus, 45 per cent of the unmarried and 49 per cent of the married (including divorcees and widows) had sought medical advice within a month. On the other hand, the place of residence seems to play a certain rôle; inasmuch as 52 per cent of the patients from the Copenhagen area, but only 45 per cent of those from provincial towns with over 4,000 inhabitants and 36 per cent of those from the rural districts had gone to consultation within a month after the first manifestation of the symptoms. As regards the last of these groups, the reason may perhaps in some cases have been the somewhat longer distance to the nearest physician; as regards the patients from the provincial towns this cannot have been the cause, as there in all these is at least one practising physician.

Length of Delay between the first medical Examination and the Institution of adequate Therapy. — Table V shows the length of time elapsed from the first medical examination of the patient to the moment when adequate therapy was instituted. About three-fifths of the cases (59 per cent) came under treatment within a week, about four-fifths (78 per cent) within a month, 86 per cent within three months, 91 per cent within six months. The Table further shows that the delay from the first medical examination to the time when they came under treatment was considerably longer for the patients above the age of fifty than for those under that age.

In order to find out why not all the patients came under treatment immediately after the first medical examination, I have tried to ascertain the cause of the delay in all the cases in which over a month elapsed before any therapy was instituted. (It must be noted, though, that the information obtained is in part only such as has been given by the patients themselves.) As the cases which were either technically inoperable or

Table V

Length of delay between first medical examination and institution of adequate treatment in carcinoma of the breast in women

Age at first medical examination (years)	1 Week or less	1 Month or less	3 Months or less	6 Months or less	12 Months or less	Total No. of cases
	Per cent	Per cent	Per cent	Per cent	Per cent	
< 40	48	65	78	90	95	40
40—49	45	68	78	84	93	107
50—59	63	85	92	93	97	121
60—69	66	84	91	92	95	128
≥ 70	67	78	86	91	97	79
All ages	59	78	86	91	95	475

biologically inoperable owing to the patient's age were not always sent to hospital treatment at once, even when the physician had diagnosed them as cancer, I have eliminated those in which the patient was over seventy years old at the time of the first examination, or which already at that time were technically inoperable. There then remain 76 patients. Eight of these absolutely refused operation, four had to wait over a month before they could be received by the provincial hospital to which they had been referred, four had consulted a physician who advised dietary treatment (uncooked food). Of the remaining 60, twelve had been referred to some specialist or hospital service (incl. the Radium Center). In three of these cases, the specialist consulted had confined himself to keeping the patient under observation; in five, the bio-assays (3 excisions, 2 trephine biopsies) made by the specialists or at the hospitals had been inconclusive; in four cases at the Radium Center the diagnosis was not established at once, because trephine biopsy failed to show cancer. All the twelve cases were operable at the time when the diagnosis was established; in all of them radical operation was performed, and in seven axillary lymph node metastases were found (among these were two of the cases at the Radium Center). In the remaining 48 cases, the physician first consulted had declared that it was not cancer, that it was nothing serious, or had advised to wait and see how things developed; then if the tumor grew larger the question of operation might be considered. Two patients had, according to their statements, not been examined by the consulted physician at all.

These 48 patients constitute 12 per cent of all the 396 women with mammary carcinoma under seventy years of age. There are relatively most in the young age classes; they constitute 15 per cent of those less than 40 years old, 19 per cent of those between 41 and 49, 8 per cent of those between 50 and 59, 9 per cent of those between 60 and 69. Thirty-six of them (*i. e.* 9 per cent of the 396) did not come under treatment until over 3 months after the first examination. Of these thirty-six, 4 were technically inoperable, 29 were radically operated upon, and in 14 of these histologically demonstrable axillary metastases were found. That is to say that 89 per cent were technically operable and in 52 per cent of those radically operated on there was no axillary involvement. This corresponds rather exactly to the distribution in the whole material (see Table VII). Thus, it is evident that these were patients who had come to first examination early, and in whose cases it had therefore been more difficult to establish the diagnosis clinically. Besides, as most of them belonged to the relatively younger age classes, the physicians have been more inclined to count with the tumor being a benign growth — fibroadenomatosis or fibroadenoma. Even for very experienced investigators it is often extremely difficult, if not impossible, to establish the diagnosis of breast cancer clinically; and for the general practitioner, who com-

paratively seldom has occasion to see such cases, it is, of course, still more difficult. It would therefore be well if the practising physician would not only examine all patients over twenty years old with mammary symptoms very thoroughly, but would also send any one whom he found to have even a very small tumor or induration in the breast either to a specialist or to a hospital, where the tumor may be removed for microscopy or biopsy be made, or the involved portion be excised in case of the least suspicious induration.

Length of Delay between the Appearance of the first Symptom and the Institution of adequate Therapy. — Table VI shows the length of time elapsed from the observation of the first symptom to the moment when adequate therapy was instituted. Only about one-third (32 per cent) of the patients came under treatment within a month, about one-half (52 per cent) within three months, about two-thirds within six months. In this respect, there does not seem to be any difference as regards the different age classes, and the fact that the patients under 50 years of age came to first medical examination earlier than those in the older age classes has thus been counterbalanced by the longer delay between their examination and the time when they came under adequate treatment. The same is the case as regards the delay between the first observation of the mammary tumor and institution of therapy in the 414 cases in which the tumor was noticed before the first medical examination, except that the percentage of cases within each of the different time intervals is, of course, a little larger; thus, 21 per cent came under treatment within two weeks or less, 36 per cent within a month or less, 54 per cent within 3 months or less, 68 per cent within six months or less, 81 per cent within a year or less.

Table VI

Length of delay between observation of first symptom and institution of adequate treatment in carcinoma of the breast in women

Age at observation of first symptom (years)	2 Weeks or less	1 Month or less	3 Months or less	6 Months or less	12 Months or less	Total No. of cases
	Per cent	Per cent	Per cent	Per cent	Per cent	
< 40	18	31	49	64	84	45
40—49	16	32	49	67	82	109
50—59	16	34	57	71	80	129
60—69	19	31	51	67	80	118
≧ 70	22	31	47	64	82	74
All ages	18	32	52	67	81	475

Table VII shows how the operability depends on the time that elapses from the moment the first symptom is noticed till adequate therapy is

Table VII

howing the relation between delay and operability, and between delay and stage of disease when treatment was instituted

Delay	No. of cases	Technically operable	Radically operated on, in ratio of technically operable	Cases in Stage I in ratio of number operated on	All cases		
					St. I	St. II	Inoperable
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
2 Weeks or less	84	100	92	59	59	41	0
2 Weeks—1 Month	69	94	95	56	53	41	6
1 –3 Months	92	89	87	48	43	46	11
3 –12 Months	140	77	77	40	31	46	23
Over 12 Months	90	71	78	58	41	30	29
Total	475	85	85	51	44	41	15

instituted. All the cases which came under treatment within two weeks were technically operable; — which does not mean, however, that all patients who come under treatment immediately after the first symptom has been noticed are operable, since five patients first had symptoms from distant metastases; but none of these came under treatment at once. Later there is a gradual decline in the technical operability, to 77 per cent for those who did not come under treatment until over a year after the first symptom had manifested itself. As it is of very great significance, prognostically, whether there are histologically demonstrable axillary lymph node metastases or not, this too has been recorded. The technically operable cases did not all come to operation, either because the patient refused to be operated upon or because they were biologically inoperable on account of high age or severe diseases. For the sake of readier survey, there is last in the Table shown the proportion between cases without demonstrable axillary metastases (stage I), cases with axillary metastases (stage II), and technically inoperable cases, presuming that the proportion between stage I and stage II was the same among the technically operable not operated upon as among those that came to operation. (The potential error, if any, cannot be very great.) It will be seen that of the cases which came under treatment within two weeks 59 per cent were in stage I, 41 per cent in stage II, and there were no inoperable. With increasing duration of the symptoms the number of stage I cases becomes steadily less and there is a gradual increase in the number of inoperables, whereas the number of stage II cases does not show great variations. With a duration of over a year there is again an increase for the cases in stage 1, however. The explanation of this must be that this group contains a greater number of the particularly slow-growing, late

metastasing tumors, and perhaps also that the mammary affection may not have been malignant from the beginning.

If we instead examine the length of delay between the first observation of the mammary tumor and the time when the patient came under treatment in the 387 cases in which the growth was noticed before the first medical examination, we find nearly the same percentages as in Table VII. As this Table shows, there were, in all, 44 per cent in stage I, 41 per cent in stage II, and 15 per cent inoperable. If we, as PACK & LIVINGSTON, figure with five years' freedom from symptoms after radical operation for 70 per cent of those in stage I, 22 per cent for those in stage II and no five years' freedom from symptoms for any of the inoperable, we get, in all, 39.8 per cent with five years' freedom from symptoms. If all patients came under treatment immediately after the first symptoms had been observed, it is probable that the distribution would be more or less the same as in the cases in Table VII which came under treatment within two weeks; namely 59 per cent stage I, 41 per cent stage II and no inoperable; which would give 50.3 per cent with five years' freedom from symptoms. The result of this would be that if all patients sought medical advice as soon as they noticed the first symptoms suggestive of cancer, and the physicians established the diagnosis at once and saw to it that the patients came under treatment, the proportion of cases that remained symptom-free for five years might be expected to increase from 40 per cent to about 50.

Twenty-nine per cent of the mammary tumors were less than 4 cm. in diameter, 41 per cent between 4 and 6 cm., 30 per cent over 6 cm. Of the cases that came under treatment within a week after the onset of the symptoms, 43.5 per cent were less than 4 cm., 43 per cent between 4 and 6 cm., 13 per cent over 6 cm. in diameter. With increasing duration of the symptoms, there is a gradual decrease in the number of tumors less than 4 cm. in diameter, until there with over a year's delay between the onset of the symptoms and the institution of treatment are only 20 per cent of these. For those between 4 and 6 cm. there is a lesser decrease, to 33 per cent; while the proportion of those over 6 cm. in diameter increases to 47 per cent. If we examine the dependency of the size of the mammary tumor on the length of time during which it has been observed, we find practically the same percentages. Eighty-five per cent of all the patients were technically operable. With tumors less than 4 cm. in diameter 93 per cent of these could be operated on, with tumors between 4 and 6 cm. in diameter 96 per cent, with tumors over 6 cm. in diameter only 27 per cent. Of those radically operated on 51 per cent were in stage I. Sixty-six per cent of these had tumors less than 4 cm. in diameter, 53 per cent tumors between 4 and 6 cm., 27 per cent tumors over 6 cm. in diameter. These figures clearly show that the prognosis is poorer with larger tumors.

Paget's Disease. — Seventeen patients had Paget's disease, in twelve of them associated with carcinoma. One of the patients had an ulcerating, inoperable cancer, the others no palpable mammary tumor, or at most a slight induration. The duration of the symptoms before a physician was consulted was from a few days to five years. Eleven of the patients had not sought medical advice until a year or more after the first signs were noticed. In eleven cases, the diagnosis was established at the first medical examination, in the others not until from ten months to four years later. In these cases, the physician consulted had mostly confined himself to prescribing treatment with some ointment. In twelve cases, radical operation had been performed; in eleven of these cancer was found, only three of them metastases to the axillary lymph nodes.

Sarcoma of the Breast. — The anamneses in the two cases of this type do not present anything of interest.

Breast Cancer in Males. — Of the five males with mammary carcinoma, one had consulted a physician at the first appearance of the symptom, three others after delays of respectively six weeks, a year and two years. The three last of these had not sought medical advice before because they did not attach any importance to the lump in the breast. The fifth had first noticed a cutaneous and subcutaneous metastasis below the breast, and had gone to the physician two-three months later without having been aware of the mammary tumor. The four patients had come under treatment within a month after the first medical examination; in the fifth case, the physician had not attached any significance to the nodule and the patient had not come under treatment until a year afterwards. Four of the cases were technically operable, in three of them radical operation was performed, and in two of these metastases to the axillary lymph nodes were found.

Conclusions

In the treatment of breast cancer, as in the treatment of all other forms of cancer, it is of paramount importance for the result that adequate therapy is instituted as early as possible after the appearance of the first symptoms. This can only be achieved if the patients consult a physician as soon as they have noticed the first signs which might point to cancer of the breast, and if the diagnosis is established as soon as the case gets into the hands of the physician.

Of the symptoms which should make the patient seek medical advice, the most important is the presence of a lump or induration in the breast of a woman over twenty years of age. Actual pain is seldom an early

symptom in breast cancer, but there may often be some slighter sensations in the breast, or out in the axilla, which will draw the patient's attention to the breast, with the result that the tumor is discovered; therefore, such sensations may be of great significance for the early diagnosis. Other symptoms which may be the first the patient notices are retraction of the nipple, discharge, either bloody or of a clear, yellowish fluid, from the latter, or a glandular swelling in the armpit. The presence of such a swelling will oftenest, though not always, be a sign of metastatic involvement of the axillary lymph nodes, and if so the case is not an early one.

It must therefore be considered as important to make all women understand the necessity of consulting a physician as soon as one of these symptoms is noticed. Even if this in many cases will result in women coming to doctor with a quite benign affection of the breast — for there are no early symptoms especially characteristic for mammary cancer — it will also result in many case of cancer coming under treatment in an early stage. No doubt the educational campaign conducted in recent years has made a number of patients seek medical advice earlier than before — on the average about one-third of cases now come under observation within a week, about one-half within a month, after the onset of the first symptoms — but if all patients came under adequate treatment immediately after the first symptom has been observed, it is probable that the proportion of five-years' symptom-free survivals would increase from about 40 to about 50 per cent. For the present it is difficult to estimate how much might be obtained by regular health examinations, but it would undoubtedly be very difficult to get the whole population to present themselves sufficiently often for such regular examinations.

For the practising physician the object must be to see to it that the diagnosis is established at once; and as this in early cases can by no means always be done clinically, every patient with a lump or a suspicious induration in the breast should by him be referred to a specialist or to some hospital where the tumor can be extirpated or a biopsy made. The earlier the patient comes for consultation, the more difficult is it to establish the diagnosis clinically; and what is gained prognostically by the patient seeking medical advice early ought not to be lost by failure to have the diagnosis established at once.

SUMMARY

The author presents an analysis of 500 consecutive cases of breast cancer and Paget's disease of the nipple, from the Radium Center in Copenhagen. He reviews the early symptoms, their duration from the time they were first noticed until the patients sought medical advice, and the length of delay between the first medical examination and the institution of adequate treatment. He shows the prognostic significance of

de ay and discusses the means of getting the patients under treatment as early as possi e. He points out that the material constitutes a fairly normal representation of br ast cancer such as it occurs when the diagnosis is established and the patients come un er treatment, in contrast to most of the materials from surgical services, which are ap to be more or less selected, because the cases are largely referred to them with a vie v to their operability. As he, moreover, has closely questioned all the patients hi self, and has thus obtained more precise data than can usually be obtained by the stu ly of case records, he thinks that his material gives considerably better information tha what is to be found in earlier publications of similar kind.

ZUSAMMENFASSUNG

Verf. berichtet über 500 aufeinanderfolgende Fälle von Brustkrebs und Morbus Paget der Brustwarze aus der Radiumzentrale in Kopenhagen. Er gibt eine Durchsicht der Frühsymptome, ihrer Dauer von dem Augenblicke an, wo sie erstmalig beobachtet wurden, bis der Kranke sich an einen Arzt wandte, sowie des Zeitverlustes zwischen der ersten ärztlichen Untersuchung und dem Einleiten einer sachgemässen Behandlung. Er weist die prognostische Bedeutung des Zeitverlustes nach und bespricht die Mittel, wie man die Kranken so früh wie möglich der Behandlung zuführen kann. Er betont, dass das Material eine recht repräsentative Sammlung von Brustkrebs darstellt, wie er aussieht, wenn die Diagnose gestellt ist und der Kranke zur Behandlung kommt, zum Unterschied von der Mehrzahl der Materiale aus chirurgischen Kliniken, die mehr oder weniger ausgewählt sein werden, da die Fälle in grossem Ausmasse im Hinblick auf ihre Operabilität dort eingeliefert werden. Da Verf. ausserdem alle seine Kranken selber genau befragt hat und hierdurch genauere Daten hat erhalten können, als was gewöhnlich beim Studium von Krankengeschichten möglich ist, ist er der Ansicht, dass sein Material bedeutend bessere Auskünfte liefern kann, als die in früheren Arbeiten ähnlicher Art erhältlichen.

RÉSUMÉ

L'auteur apporte une analyse de 500 cas consécutifs de cancers du sein et de maladies de Paget du mamelon, provenant du Centre du Radium de Copenhague. Il revoit les symptômes initiaux, leur durée depuis le moment où ils furent constatés pour la première fois jusqu'à celui où les malades demandèrent avis au médecin, et la longueur du délai entre le premier examen médical et l'institution d'un traitement adéquat. Il montre l'importance de ce délai au point de vue pronostique et discute des moyens d'amener le plus tôt possible les malades à se faire traiter. Il souligne que son matériel donne une idée assez normale du cancer du sein tel qu'il se présente au stade où le diagnostic est posé et le traitement entrepris, à l'encontre de ce qui se voit dans les Services de Chirurgie, où la plupart des matériels sont exposés à être plus ou moins sélectionnés parce que les cas y sont envoyés avant tout en tenant compte de leur opérabilité. Comme, de plus, il a soigneusement interrogé toutes les malades lui-même et a, de la sorte, obtenu des données plus précises que celles qu'on peut tirer de l'étude des observations, il estime que son matériel fournit des renseignements considérablement meilleurs que ceux qu'on trouve dans les publications antérieures du même genre.

LITERATURE

ANDERSSEN, M.: Nordisk Medicin *35*, 1626, 1947.
AUCHINCLOSS: Nelson Loose-Leaf Surgery. New York; vol. IV, p. 81.
BERG: Cancer, London, 1938; p. 211.

CHEATLE, G. LENTHAL: The British Medical Journal p. 47, 1927, 2.
CHEATLE and CUTLER: Tumors of the Breast. London 1931; p. 274.
DAHL-IVERSEN, E.: Lyon Chirurgical *24:* 648, 1927 and Ugeskrift for Læger, *92*, 10 0, 1930.
EGGERS, CHOLNOKY and JESSUP: Annals of Surgery *113*, 321, 1941.
GESCHICKTER: Diseases of the Breast. Philadelphia 1943 and 1945; p. 405.
HAAGENSEN, C. D. and A. P. STOUT: Annals of Surgery *95*, 336, 1932.
HARRINGTON: Surgery *19*, 154, 1946.
HOOPES, B. J. and A. B. MCGRAW: Surgery *12*, 892, 1942.
JACOBSEN, OLUF: Heredity in Breast Cancer. Copenhagen 1946; p. 54.
KUNATH, C. A.: Archives of Surgery *41*, 66, 1940.
LEWIS, D. L. and W. F. RIEFENHOFF: Annals of Surgery *95*, 336, 1932.
MACDONALD: Surgery, Gynecology and Obstetrics *74*, 75, 1942.
NATHANSON and WELCH: The American Journal of Cancer *28*, 40, 1936.
PACK and LIVINGSTON: Treatment of Cancer and allied Diseases. New York 1940; vol. I, p. 705.
VERHAVE, J. H.: Nederlandsch Tijdschrift voor Geneeskunde *70*, 2, 1082, 1926.
WEVIL, L. B.: Edinburgh Medical Journal *39*, 714, 1932.

FROM THE ROENTGEN DEPARTMENT (HEAD: DR. E. HAGBERG) AND THE MEDICAL DEPARTMENT (HEAD: DR. C. GRILL) OF THE CENTRAL HOSPITAL, BORÅS, SWEDEN

ON LUNG CHANGES IN ACUTE GENERAL DERMATITIS[1]

by

Nils Frostberg

For the last 1½ years in this Roentgen Department, examinations have been made of the lungs in all cases admitted with acute General dermatitis that showed rise in temperature or where the clinical findings were of such a nature that lung affections might be suspected. This was decided after we had had opportunity of seeing a case of acute general dermatitis with unusual lung picture in June last year.

Case I: 26-year-old woman, farmer's daughter (Med. journ. 1173/46). No previous affections of the skin. She had been infected at home with scabies, which she treated with »scab ointment» purchased at the chemist's shop. She rubbed it in all over the body for 24 hours. Immediately afterwards she fell ill with sore throat, fever up to 39 degrees and a punctiform scarlet rash covering most of the body. Scarlatina was suspected and she was remitted to the Hospital for Infectious Diseases, from where she was at once transfered here. On admission she displayed a diffuse exanthema, consisting of papules and confluent erythema on face, arms, breast, abdomen and lower limbs. Here and there marks of scratching; no definite scabies burrows. She was given scabies treatment and discharged after 5 days, as the exanthema had subsided, S. R. was 31 mm/1 hr. Hb. 81 %. Red cells 4.7 million. White cells 5,800. Diff. count showed neutr. segm. 59 %. Eos. 5 %. Lymph. 30 %. Monoc. 6 %. Heller and Almén negative. Meinicke negative.

At home she was free from trouble for a week, then fever up to between 39 and 40 deg. developed again with recurrence of the exanthema. A doctor was called. He found considerable râles in the lungs, besides albumen and red blood cells in the urine. She was readmitted here again.

On admission 8. 6. 46, she displayed strongly affected general condition. Dyspnea at rest. Temp. 40.4 deg. Pulse 160. The lips and the skin were dry. Oedema around the ankles and a little above on the lower limbs.

Skin: over the whole skin an exanthema of measles type and partly confluent. When the suction contact for lead IV in E. C. G. was removed there was seen a circular skin bleeding. *Heart:* displayed no enlargement. Sounds rather muffled. *Blood pressure:* 100/0 (when previously in hospital 145/90). *Lungs:* no evident diminution of sounds.

Submitted for publication Jan. 10, 1948.

Basally numerous râles. *White cells:* 26 500. Hb. 91 %. Red. cells 4.9 mill. *Diff. coun* : Rod nucl. neutr. 1 %, segm. neutr. 80 %, eos. 3.5 %, lymphocytes 10.5 %, mono 3 %, plasma cells 2 %. Red cell picture no remark. *Trombocytes:* 73,000. *Clotting tim* : 3 min. 15 sec. and *bleeding time* 3 min. 5 sec. (that is, normal figures). *Urine:* Heller —. *Sediment:* 1—2 red, 1—3 white cells, 1—3 hyaline casts, 0—1 granular casts. *N. P. N.* (non protein nitrogen) = 57 mg%. *E. C. G.* showed tachycardia, but otherwise nothing pathological.

Roentgen examination, 8. 6. 1946: What immediately attracted attention on screening was that the lung fields were so condensed. On the Roentgen picture (fig. 1 and 2), generally increased coarse reticular markings in the lung fields but no appreciable parenchymal infiltrate. As the hilar areas with the vessels were of normal appearance and the size and shape of the heart were normal, we considered that stasis could be excluded. Owing to the tendency to skin bleeding we suspected that the lung changes were also due to bleedings and, basing on the coarse reticular pattern, we supposed that these lay interstitially, an assumption that was supported by study of the literature.

The patient lay for a little more than a week with fever between 38—39 deg. (one peak up to 39.6 deg.). She was given penicillin (25,000 + 15,000 units × 8) but it was only after 9 days that the temperature fell and she was improved subjectively. The exanthema faded and the skin became dry and scaly, particularly in the face, on the arms and on the trunk. The blood pressure had been low, 80/60, for a time but rose to normal figures. *S. R.* which on admission was 16 mm/1 hr. rose to 30 mm/1 hr. The white blood cells first rose to 33,200 but dropped as she improved to 8,700.

Other laboratory tests showed: on 16. 6. the serum albumin was 6.0 %, on 14. 6. blood culture, no growth. *Urine:* Heller persistently negative. Nothing pathological in the sediments. On 29. 6. urobilin was +++ but urobilinogen negative. Bouma neg.

Two weeks after admission a *repeat radiograph* was taken (fig. 3). It now displayed quite normal conditions in the lung fields. After about 1 month the patient was discharged. The skin was then normal.

The patient had only been home about one week, however, when she fell ill, this time with sharp stitch in the breast to the left and fever up to 39 deg. She was again readmitted. She was then in good general condition. Temp. 38 deg. Skin dry and scaly, over the whole trunk and arms there was a fine red exanthema consisting of small confluent papules. White cells were 11,300. S. R. 50 mm/1 hr. Heller and Almén neg. N. P. N. 27 mg%. Mantoux test, with 0.05 mg and 1 mg negative.

On examination of the lungs there was found deadening of the left base murmur but otherwise nothing definite.

Roentgen now showed a basal parenchymal congestion on the left side. The diaphragm arch was drawn upwards (pleuropneumonia). The lung marking in the lung fields was otherwise completely normal.

This time she was given sulfadimine and the temperature fell rapidly. The pulse remained the whole time around 80. On Roentgen control of the lungs the left-side process showed rapid retrogression.

The patient was discharged afebrile after two weeks, following which she was kept under policlinic control. The general condition improved. The skin was normal the whole time. Two months after the last period in hospital she was entirely able to work. Heller and Almén neg. S. R. 7 mm/1 hr. In reply to telephone inquiry recently, one year after last discharge from hospital, she stated she had been in good health the whole time and had no skin eruption. When specially questioned, she also stated that she had never had trouble with cough or fever when during threshing she was subjected to severe dust contact.

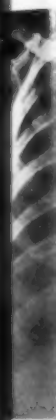
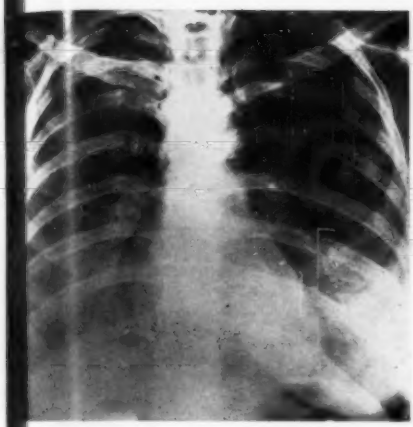


Fig.



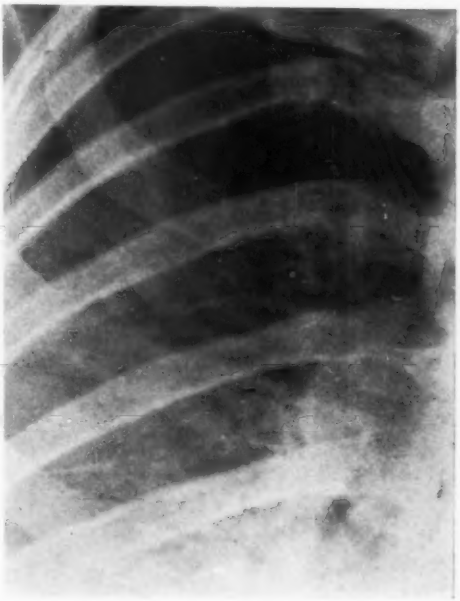


Fig. 1. Fig. 2.

Fig. 1 and 2. First case. Generally increased reticular pattern in both lung fields.

Fig. 3. Fortnight later. Lung changes disappeared.

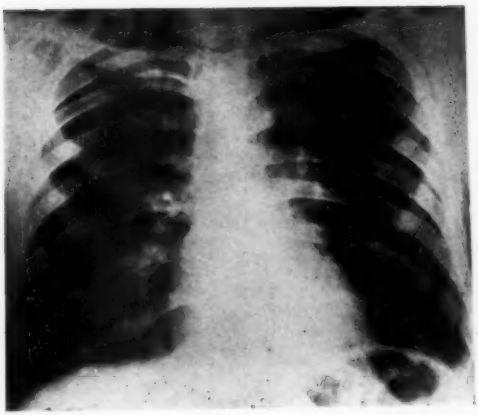


Fig. 4. Fig. 5.

Fig. 4 and 5. Second case. Bilateral streaky density basally.

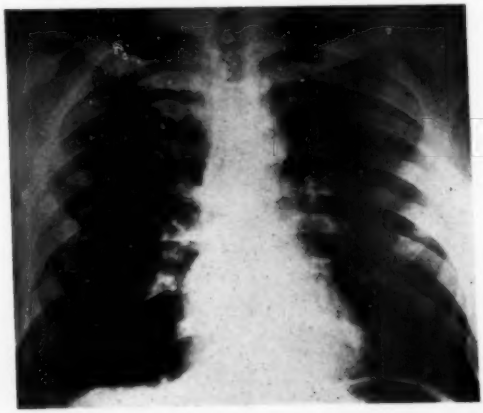


Fig. 6. Control 6 days later. Lung changes disappeared.

In view of the Roentgen findings in the case related above, we decided ta make a Roentgen examination of the lungs in future for all general de matitis admitted where the slightest suspicion of lung affection is pr sent. At the beginning of this year a new case was observed with similar lu g changes.

C a s e I I: 40-year-old man, no previous skin disease. In August 1946 was operated for perforated ulcus duodeni at this hospital (surg. Journal 2174/46). At the beginning of February he again had stomach trouble of ulcus duodeni type. Was admitted to the medical department on 6. 2. 1947 (med. journal 353/47) and the Roentgen examination displayed pronounced gastritis and an ulcus deformed bulb with a niche larger than a pea.

After about one week in the hospital the patient contracted a dermatitis, which was assumed to be due to the fenemal medication (0.05 × 3 for 9 days). It started in the form of itching of the fingers, the itch then spreading rapidly over the whole body. After one day there were pinhead spots on slightly reddened skin, first on the arms, later on trunk and limbs as well. The redness became more and more intensive in the next few days, finally being rather cyanotic. The skin was infiltrated and exsudation was observed on the limbs. The temperature began to rise to 38—39°. No thoracic pains. On the *Roentgen examination* 19. 2. 47 (fig. 4 and 5) there were found mottled and reticular parenchymal changes on both lungs, mostly basal, and in addition a small filling in left sinus pleurae. — On auscultation the breath sounds on the left base were somewhat altered and a couple of days later numerous crepitating râles were heard in both bases. *S. R.* was 6 mm/1 hr. *Hb.* 108 %. *Red cells* 5.2 mill. Count of *white cells* was normal. Diff. count showed neutral staff cells 2 %, segm. 57 %, eos. 12 %, bas. 0 %, lymph. 23 %, monoc. 6 %. Thus an evident eosinophilia. *Mantoux*, tested with 0.05 mg., gave reaction 10 × 10 mm. Penicillin was administered and after a couple of days the temperature returned to normal. The skin faded and displayed a finely lamellar scaling. *Roentgen* control 25. 2. 1947 (fig. 6) only 6 days after showed an appreciable decrease of the lung changes and at further Roentgen examination a little over a month later the lung picture was completely normal. The patient's stomach troubles disappeared with customary ulcus treatment and on Roentgen examination 3 weeks after admission the niche had gone.

On subsequent inquiry it was found that this patient was not subject to any noticeable dust contact of any kind either.

We are thus concerned with two cases of lung changes in connection with general acute dermatitis.

The first case is a 26-year-old woman previously healthy, who after treating herself with mercury ointment becomes ill with acute dermatitis in the shape of extensive morbilliform exanthema with tendency to skin bleedings. The general condition is considerably affected, with high fever and rapid pulse and low blood pressure. Evident leucocytosis without signs of eosinophilia. The trombocyte count is lowered but the bleeding time and the clotting time are normal. She has slight albuminuria and moderate N. P. N. rise. The Roetgen examination shows a generally increased reticular pattern in both the lung fields but no appreciable parenchymal infiltrate. A little more than a week after the temp. falls

abruptly, the exanthema fades and the lung changes disappear. After return home, about 5 weeks following the preceding illness the patient contracts a left-side pleuropneumonia, clinically and roentgenologically, which quickly yields to chemotherapy. Except for the left basal pleuropneumonia the lung pattern is then completely normal. Since then healthy.

The other case applies to a 40-year-old man treated for ulcus duodeni, who while in hospital contracts a particularly intensive dermatitis over the arms, trunk and legs. The skin is reddened, partially cyanotic and infiltrated and even exsudating. The dermatitis is believed to have supervened in connection with fenemal medication (barbituric acid preparation). Temp. rises to 38—39°. On Roetgen examination there are found small mottled and reticular parenchymal densities in both the lung fields, chiefly basal. S. R. shows no rise, nor is any leukocytosis seen. Diff. count shows a moderate blood eosinophilia 12 %. The lung changes found by Roentgen disappear at the same time as the exanthema fades.

In neither of the two cases are there clinical signs of infection of the upper air passages, neither had cough. No sign of tbc affection was found. The anamnesis provided no support for any form of pneumoconiosis.

Each of the cases described presents great interest. As differential diagnosis it would seem that all the chronic disease conditions that give disseminated lung changes in the form of fine spotted or mottled pattern (including miliary tbc, periarteritis nodosa, lymphogranulomatosis) can be excluded. Nor does the picture resemble chronic lung stasis or lung oedema. The hilar areas and the vessel stems show no such changes as is usual to find in these conditions. Nor were there found clinically or electrocardiographically or by Roentgen any changes that might indicate heart affection. The low pressure in the first case would seem to be due to shock condition in the nature of collapse, in which the patient was. From a purely roentgenological point of view the picture might resemble that in *hemosiderosis pulmonum*. The lung changes in this disease are described by a number of authors, including J. WALDENSTRÖM and ANSPACH. The anamnestic and clinical findings and the parallelism between the lung changes and the dermatitis, however, are against this diagnosis. E. TÖRNELL has described a form of *pneumoconiosis* (*pneumomycosis*) caused by inhalation of dust (Monilia albicans). In this the lung fields are found to be, chiefly centrally and basally studded with small indefinite mottled congestions. The hilar shadows are usually rather enlarged. At times the congestions are confluent. These changes may disappear in the course of weeks or months and the lung picture again become normal. In cases described no points of support accounted for such a genesis of the lung changes.

Of the acute lung affections that must be reckoned with in differential diagnosis the first to be mentioned should be *bronchiolitis*. ASSMAN states that this may give a disseminated spottiness which is rather coarser than in miliary tbc. The patients had, however, no sign of air passage infection and in lastnamed case the patient did not react even with leucocytosis or increased S. R. Nor are the Roentgen plates in the cases described characterised by any mottled parenchymal congestions but it is above all the pronounced streaky pattern that stands out.

As regards the first case there was clearly mixed with the skin changes the picture of a *purpura*. Even the little suction contact of the E. C. G. lead gave evident skin bleeding (brittleness of vessels?) and trombocytes count was lowered to 73,000. LOMHOLT declares that purpura as a rule is an accessory phenomenon in some other diseases. Among other things, many skin affections (erythema, papules, vesicles) have a haemorrhagic tendency, when the process becomes particularly intensive or the patient is in a very low condition. Among the secondary purpura forms he mentions one, idiosyncratic purpura, which is observed after administration of a number of drugs, *e. g.*, quinine, salvarsan, mercury and others. One may also contract such purpura after some soporifics (including barbituric acid preparations). He considers that in all these cases the cause is probably an allergic reaction, but the actual circumstances are not determined. A similar opinion is to be found in the great work of SUTTON and SUTTON »Diseases of the Skin».

Bleeding of skin and mucous membranes is common in purpura. The mucous membrane bleeding may lead to haemoptysis. That our patient did not have coughing up of blood may support our suspicions that the lung changes were due to interstitial bleedings in the lung tissue. In the literature a similar occurrence is mentioned in one work. It is a paper by PAPE 1933 and concerned lung changes in a case of thrombopenia purpura. The work is cited in ASSMAN's: »Klinische Röntgendiagnostik». It was a case of a 21 year old pregnant woman who had taken quinine with the object of abortion. She became ill, had rise in temperature and haemoptysis. After a couple of days the body was covered by spots the size of a pea, and on the tongue and the buccal mucous membrane there were blue-red blisters. The thrombocyte count was 45,000. The time of bleeding was prolonged. Roentgen taken because of haemoptysis showed an increased lung marking pattern. This consisted of irregular rather broad streaks of moderate density, partially arranged in form of net. Towards the periphery could be seen at several places fine irregular spots varying in size from a pinhead to a pea. Six days later the exanthema and the lung changes had gone and the blood picture was normal. Discussing the lung picture he declared that in all probability it was a question of multiple small pulmonary bleeding centres with an acute haemor-

rhagic diathesis of the type thrombopenia purpura. — If bleedings are located in the alveoli there should be fine spottiness, whereas there should be increased streak shaped pattern if they are located interstitially. The pictures he shows very much resemble those of our first case.

Obviously it is difficult to take this as evidence, as no histological diagnosis can be obtained. There is, however, a work by ANSPACH 1933: »Miliary hemorrhages on necropsy roentgenograms of children», which deserves mentioning in this connection. He has examined by Roentgen the thorax on the corpses of two children who died of acute bacterial dysentery. The radiographs that were taken a short while after death showed finely spotted densities over both the lung fields of the type to be found in miliary tbc. One of the plates published (Case I) is characterised by a network and finely spotted pattern practically uniform over both lung fields. In this histological examination he found small capillary bleedings in the parenchyma but no sign of inflammatory reaction.

In regard to my second case, the picture is not quite the same either clinically or roentgenologically. His dermatitis is certainly particularly violent and extended, with cyanotic tendency, but general conditions is not affected. Unfortunately thrombocyte count or determination of bleeding time and clotting time was not undertaken, as we had not purpura in mind in that case. The clinical picture (no leucocytosis and normal S. R.) hardly allows of the diagnosis bronchopneumonia, nor is the Roentgen picture typical for such an infiltration. An affection that in such a case must be reckoned with, according to LÖFFLER, is *transitory lung infiltration*. The changes, indeed, disappeared with particular rapidity and the patient had a moderate blood eosinophilia. Nevertheless the eosinophilia is not more pronounced than can be explained by the dermatitis (see SCHÜRCH). The lung infiltrations are perhaps rather more finely spotted and netshaped than is found in Löfflers syndrome.

In this case, though hardly in the first one, the lung picture could naturally resemble that in *virus pneumonia* and the objection may be made that it is a case of coincidence between dermatitis and virus pneumonia. Such lung changes have in recent years been described in several different quarters, particular America and England. They pass under different names, such as primary atypical pneumonia, virus pneumonia, pneumonitis. LENK has described thorougly the roentgenological changes and proposes the name *»acute interstitial pneumonia»*. »Es handelt sich im Wesentlichen um eine akute Enzündung des Stützgerüstes der Lunge im Gegensatz zur Affektion des eigentlichen Lungenparenchyms ...» Among the clinical characteristics may be mentioned: slowly rising temp. to 38—39° and temperature fall »en lysis». The general condition is hardly affected but often the patient has troublesome cough. The physical findings are insignificant. Sometimes there is leucocytosis. S. R. is often

strongly raised. No eosinophilia. The infection is resistent to sulfa and penicillin. Positive cold agglutination reaction is present. — In our cases described, cold agglutination test was not made as we had not considered that.

KNUTSEN in 67 cases of »primary atypical pneumonia» found skin symptoms or skin complications in 10 cases. These were herpes simplex, urticarial or more uncharacteristic exanthema, stomatitis and balanitis. There are descriptions from America (STANYON and WARNER and others) of the combination pneumonia and erythema multiforme exsudativum.

The skin changes in the above cases do not resemble erythema multiforme exsudativum. Nor do the clinical course and the other laboratory findings indubitably support the idea that lung changes such as are found with virus pneumonia are concerned.

In the dermatological literature available nothing is mentioned of lung changes with acute dermatitis. In a work by BILLO on acute mercury dermatitis, where a number of the cases showed purpura tendency, the indication is given in many places in the status »negative chest» but Roentgen examination had evidently not been made. Probably there seldom seems reason for Roentgen examination, as the acute skin symptoms might well explain both a moderate rise in temperature and a temporary effect on the general condition.

Simultaneous allergic manifestations from skin and internal organs are not unusual. The fact that the lung changes in the above described cases set in and disappear simultaneously with occurrence and fading of the exanthema leads one to conclude that the patient's hypersensitiveness caused the lung as well as the skin changes. The appearance of the Roentgen picture and the clinical findings warrants the suspicion that the changes lie in the interstitial tissue of the lung. We shall in future follow all such cases with the greatest attention.

SUMMARY

The author gives an account of two patients where lung changes mainly in the form of increased reticular pattern were observed at the same time as acute general exanthema. With the fading of the exanthema the lung changes also disappeared so that it may be justified to suspect that the patient's hypersensitivity is the cause of both.

ZUSAMMENFASSUNG

Verf. berichtet über zwei Patienten, bei denen, neben einem akuten, allgemeinen Exanthem, Lungenveränderungen, hauptsächlich in Gestalt wabenförmig verstärkter Zeichnung, beobachtet wurden. Beim Abblassen des Ausschlages verschwinden auch die Lungenveränderungen, weshalb man wohl vermuten darf, dass die Überempfindlichkeit des Kranken beide Erscheinungen verursacht hat.

RÉSUMÉ

L'auteur décrit deux cas chez qui il a observé la coïncidence d'altérations pulmonaires parenchymateuses surtout sous forme d'un épaississement de la trame pulmonaire et d'un exanthème aigü généralisé. Les modifications parenchymateuses ayant disparu en même temps que l'exanthème s'attenuait, on est en droit de supposer que l'hypersensibilité du patient est la cause de ces deux conditions.

BIBLIOGRAPHY

1. Aarseth: Nord. Med. 34, 1947, p. 934.
2. Anspach: Am. Journ. of Roentgen. 30, 1933, p. 768.
3. Anspach: Am. Journ. of Roentgen. 41, 1939, p. 592.
4. Assman: Klinische Röntgendiagnostik, Berlin 1934.
5. Billo: Am. Journ. of the Med. Soc. 201, 1941, p. 756.
6. de Fine Licht: Acta Radiolog. 23, 1942, p. 151.
7. Eckerström: Hygiea 1936, p. 198.
8. Fitz-Hugh: J. A. M. A., 111, 1938, p. 1643.
9. Gravesen: Bibliot. for Læger 130, 1938/1939, p. 235.
10. Gravesen: Acta med. scand. 96, 1938, p. 523.
11. Hansen-Pruss and Goodman: Annals of Allergy 2, 1944, p. 85.
12. Harkavy: Arch. of Int. Med. 67, 1941, p. 709.
13. Hennell and Sussman: Radiology 44, 1945, p. 328.
14. Judd: Diseases of the Chest, Diagnosis and Treatment, Philadelphia, F. A. Davis Company 1947, p. 503.
15. Knutsen: Nord. Med. 36, 1947, p. 2099.
16. Lenk: Acta Radiolog. 27, 1946, p. 115.
17. Lomholt: Hudsygdommene og deres behandling. Copenhagen 1944.
18. Löffler: Beitrag. z. Klin. d. Tub. 79, 1931/1932, p. 368.
19. Löhr: Zeitschr. f. Klin. Med. 137, 1939, p. 297.
20. Meyenburg: Schweiz. Med. Wochenschr. 23, 1942, p. 809.
21. Meyenburg: Virchows Archiv f. Patholog. Anat. 309, 1942, p. 258.
22. Nordisk Lærebog i Intern Medicin, Copenhagen 1943.
23. Obendorfer: Fortschr. Rtg. str. 37, 1928, p. 235.
24. Pape: Fortschr. d. Geb. Rtg.str. 47. 1933, p. 491.
25. Pirkle and Davin: Am. Rev. of Tuberculosis 50, 1944, p. 48.
26. Schürch: Dermatologica 1942, p. 297.
27. Stanyon and Warner: Canad. Med. Ass. Journ. 92, 1945, p. 427.
28. Stewart, H. Jones and Charlton R. Sonders: The New Engl. Journ. of Med. 231, 1944, p. 356.
29. Sutton and Sutton: Diseases of the Skin, London 1939.
30. Svanberg: Acta Radiolog. 26, 1945, p. 307.
31. The Commission on acute resp. diseases. Arch. Int. Med. 78, 1946, p. 687.
32. Törnell: Nord. Med. 27, 1945, p. 1513.
33. Törnell: Nord. Med. 31, 1946, p. 2106.
34. Törnell: Nord. Med. 31, 1946, p. 2149.
35. Waldenström: Acta Radiolog. 23, 1942, p. 151.

FROM THE UNIVERSITY HOSPITAL ROENTGENOLOGICAL DEPARTMENT, OSLO, NORWAY
(CHIEF: PROFESSOR TORLEIF DALE, M. D.)

A NEW PROTECTOR IN CEREBRAL ANGIOGRAPHY[1]

by

Arne Engeset

RIECHERT (1943) points out that measurements during one exposure had shown that the hands of the surgeon in angiographic work were exposed to a radiation dose of 0.2 or 0.3 r. He therefore shields the patients with lead rubber up to the neck, and a lead protector shields the hands of the surgeon also during the exposures.

LINDGREN (1946) shows a protector of angular form fastened to the skull table.

As far as I am aware there are no more references to protectors for such work in the literature. Protectors for angiographic work naturally have to be of various types to suit the different working methods. In angiography in which the carotid arteries are exposed, such protector has to be sterilized. In percutaneous angiography, however, which is now the routine method, such precaution is unnecessary. As we have between 300 and 400 angiographic examinations annually, and as the injections of contrast for this examination are performed usually by the same physicians, the risk of radiation injuries, especially to their hands, have to be considered.

The routine angiographic examination incorporates two exposures in the frontal injection, two in the lateral, and two in the half-axial view (35 degrees tilting of the tube cranially). Besides, we may have to repeat one or more injections to get better contrast in the vessels, and we frequently inject contrast in the one carotid artery with simultaneous manual compression of the other to get bilateral filling of the intracranial vessels. When we have five or six patients for angiography in one day, the surgeon may be exposed to radiation from 40 to 60 exposures a day.

To minimize the primary radiation on the hands of the surgeon some clinics utilize long radiographic cones. In the Lysholm-Schønander skull table the primary ray is very well centered, and the cassette in the sliding

[1] Submitted for publication, Febr. 28, 1948.

Fig. 1. Protector hanging from the ceiling ready to be lowered down at any time.

Fig. 2. Protector placed as for exposure.

drawer has a bottom of lead. Primary radiation, therefore, is minimized. The rubber tube between the needle and the syringe permits the surgeon to keep his hands outside the primary rays.

The personnel partaking in this examination also wear lead aprons shielding the front part of the body and reaching to the jugulum. The hands of the surgeon, however, may be exposed to secondary rays, and we have installed, therefore, a new protector to reduce also this radiation. The protector, which is suspended from the ceiling above the skull table, does not interfere in any way with the work. Its dimensions are: thickness — 3 mm lead rubber (lead equivalent 0.8 mm lead), length — 62 cm, width — 60.6 cm. In the centre is a lead glass window (22 cm × 16 cm) of a thickness of 7 mm. This window permits the surgeon to watch the face of the patient during the injections.

The protector is counterbalanced, so that it may be lowered down during the exposures and elevated when not in use. It has proved practical in use. In cases when an assistant is performing manual compression

Fig. 3. Protector in position for exposure. Does not interfere with the injection technique. Seen from the side.

of the contralateral carotid artery to get bilateral filling of the intracranial vessels, the hands of the assistant are also protected.

In order to get a more accurate impression of the protection, and of the possibilities of radiation injuries, N. H. Moxnes, Ph. D., Director of the Government Physical Laboratory, has measured the amount of radiation which may menace the personnel. These measurements and his report are as follows:

»The roentgen rays were measured with condensor chambers. The smallest amount of r that can be measured with them is 0.0007 r. One chamber was placed in the region where the physician has his hands during the operation, another in the region at his feet. The other chambers were near the genital region of the different persons attending the patient.

In the following table are compiled the amounts of r observed during a series of exposures, the dosage rate, r/seconds as counted for each exposure, the effective dosage, and the dosage rate counted for the whole

Table 1

Conditions of roentgen-rays: 4 valve generator. Kilovoltage between 50—62 KV. Each exposure 0.8 sec.

Points according to drawing	Amount of milli-r					Effective dosage rate 10^{-6} /sec.					Average dosage rate 10^{-6} r/sec.				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
No shield and aprons 6 exposures Integration of time 4.8 sec. Operation time 10 min.	34		<0.7	5.6	4.2	7 100		<150	1 200	900	57		<1.2	9	7
With shield and aprons 20 exposures Integration of exposure time 16 sec. Operation time 60 min.	2.8	<0.7	1.4	<0.7	11	180	< 44	90	< 44	690	0.8	<0.2	0.4	<0.2	3.1
With shield and aprons 50 exposures of which 44 at 62 KV and 6 at 50 KV Integration of exposure time 40 sec. Operation time 120 min.	19.6	1.4	<0.7	<0.7	<0.7	500	35	< 18	< 18	< 18	2.8	0.2	<0.1	<0.1	<0.1
With shield, aprons and patient, but no operations going on 30 exposures at 62 KV Integration of exposure time 24 sec. Operation time 60 min.	<0.7	<0.7	<0.7	<0.7	<0.7	< 30	< 30	< 30	< 30	< 30	<0.2	<0.2	<0.2	<0.2	<0.2

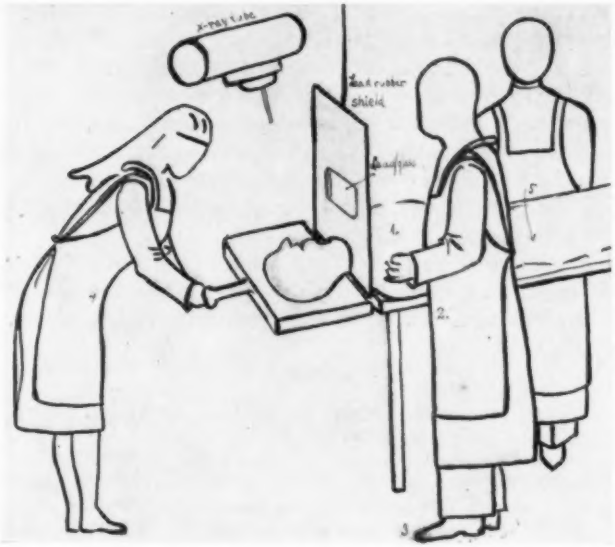


Fig. 4. Condensor chambers placed according to the numbers of the attending persons. The hands of the nurse are holding the »long» handle of the upper cassette after the first exposure. During exposures the nurse keeps her hands away, according to the visible movements of the electric timer and the signal lamp in this apparatus.

time the operation took including the intervals between the exposures, the average dosage rate.

Conditions of roentgen rays: 4-valve generator. Kilovoltage between 50 and 62, 200 MA. Each exposure 0.8 seconds.

As some authors state that short exposures of roentgen rays with intervals of a few minutes have the same biological effect as continuous roentgen rays of an *average dosage rate*, I would draw attention to the last column in the table showing the average dosage rate. As this may be somewhat unreliable, however, the *effective dosage rate* has been given in the second column in the table. It may be concluded from this that the operation with no shield and aprons gives larger average dosage rates than the tolerance dosage rate of 10^{-6} r/seconds. The observation at the end of the table, where no operation disturbed the performance, shows that the shield and aprons give full protection to the different points measured (see schematic drawing) with dosage rates well below the tolerance limit. The observations during the operations show that the operator and the other persons present must be careful to have the shields and aprons correctly placed.»

SIEVERT (1946) suggests that it may be advisable to fix the safety tolerance dose for general irradiation at 0.01 r per day. The dosage rate is not discussed in this connexion. It is in agreement with the conclusion arrived at by SIEVERT that it is advisable to measure the risk of irradiation in different radiological work as we have done here. We must try to get an impression of the value of the irradiation risk and of our protector. In spite of the fact that it is difficult to exclude all risk from radiological work, it must be considered the right principle to reduce all *measurable* irradiation to a minimum in all routine work.

The values reported by RIECHERT (1943) are probably measured in the primary rays, and have hardly any practical importance for radiological work performed at an up-to-date roentgenological clinic.

SUMMARY

A new protector is described, which has proved practical in radiological work, especially for percutaneous cerebral angiography. Measurements with condensor chambers have shown that the risk of irradiation is reduced. The protector is counterbalanced, so that it may be placed in position and removed without interfering with the examination taking place. A lead window fitted into the protector permits the surgeon to watch the face of the patient during the injection of contrast.

ZUSAMMENFASSUNG

Es wird ein neuer Schutzschirm beschrieben, der sich in röntgenologischer Tätigkeit als praktisch bewährt hat, besonders bei perkutaner Gehirnangiographie. Messungen mit Kondensorkammern haben erwiesen, dass die Bestrahlungsgefahr vermindert wird. Der Schutzschirm hat ein Gegengewicht, so dass er eingeschaltet und entfernt werden kann, ohne die vorsichgehende Untersuchung zu stören. Ein Bleiglasfenster ist in den Schutzschirm eingeschaltet, so dass der Chirurg während der Kontrasteinspritzung das Gesicht des Kranken beobachten kann.

RÉSUMÉ

Description d'un nouveau protecteur qui a prouvé sa valeur pratique pour le travail radiologique, en particulier pour l'angiographie cérébrale transcutanée. Des mesures avec les cellules d'ionisation ont montré que le risque d'irradiation est diminué. Le protecteur est équilibré, de sorte qu'on peut le mettre en place et l'enlever sans gêner l'examen en cours. Une vitre plombée enchâssée dans l'appareil permet au chirurgien de surveiller la figure du malade pendant l'injection de la substance opaque.

REFERENCES

RIECHERT, TR.: Die Arteriographie der Hirngefässe. Lehman, München—Berlin, 1943.
LINDGREN, E.: The Technique of direct (percutaneous) Cerebral Angiography. Brit. Journ. of Radiol. XX. No. 236, 326. 1946.
SIEVERT, ROLF: The Tolerance Dose and the Prevention of Injuries caused by Ionizing Radiations. Brit. Journ. of Radiol. XX. No. 236, 306. 1946.

FROM THE ROENTGEN DEPARTMENT OF THE ST. ERIK'S HOSPITAL, STOCKHOLM, SWEDEN
(HEAD: DR. C. SANDSTRÖM)

STUDIES OF THE ARTERIAL PULSE WAVE[1]

by

Åke S. Gidlund and *I. G. Porjé*

In the physician's daily practice, study of the pulse and blood pressure yields significant data concerning the circulation. Through this study a general insight is obtained into the way in which the heart works, the condition of the vessels, etc.

Attempts made during the past century to analyze the arterial pulse wave further have increased our knowledge of arterial dynamics. For various reasons, these studies have as yet been only of theoretical interest. The methods employed are often relatively intricate and difficult to master, while the extremely complicated physico-mathematical procedure involves a number of approximations. (A. APÉRIA has made an excellent critical-historical survey of hemodynamical problems in his doctoral thesis, »Hemodynamical Studies».)

In solving certain central problems, such as calculation of stroke volume, it is not sufficient to merely record pulse and blood pressure. The cross section of the aorta (Q) must also be determined. An attempt has been made to surmount this difficulty by the use of dimensions obtained statistically from cadaver material, but this method gives only a rough approximation, especially in pathological cases such as hypertension. Roentgenological determination of the cross section of the aorta has been investigated by one of the authors (Å. GIDLUND). It also seems possible to study the pulsations of the aorta in more detail by means of a special kymographic examination method worked out by Dr. GIDLUND.

Thus roentgenology seems to bring us nearer to the solution of some particularly difficult problems. A more detailed report will follow later.

Theoretical discussion

The relation between wave velocity (c) and volume elasticity modulus ($\varkappa$) is as follows:

Submitted for publication, Jan. 24, 1948.

$$c = \sqrt{\frac{\varkappa}{s}};\quad s = \text{the specific gravity of the blood} \quad . \quad . \quad . \quad (1)$$

$$\varkappa = \frac{\Delta p}{\Delta v} \cdot V$$

Δp = the increase in the pressure and Δv the corresponding increase in the volume element V of the vessel. The relation expressed by equation (1) is valid provided Δv increases proportionally to Δp, which is not the case, but approximations may be allowed when blood pressure amplitude is not great in proportion to the average pressure. Thus if the wave velocity c is known, $\varkappa$ can be determined in accordance with the above; c can be determined with the aid of harmonic analysis (PORJÉ) or by FRANK's method, *i. e.* the determination of the time differences between corresponding points (points which lie $^1/_5$ of the way up the ascending limbs of the central and peripheral pulse curves). This portion of the curve contains most as only higher frequencies which are not reflected.

If lengthwise stretching of the aorta is ignored, $\varkappa_k$ can be determined kymographically if Δp is known and the corresponding cross section increase ΔQ of the cross section Q is kymographically determined. Valuable information is obtained concerning the elastic qualities of the aorta, particularly its elasticity in the transverse direction.

The stroke volume can be calculated with the aid of the following formula:

$$S = \frac{Q}{c \cdot s} \cdot \int_a^s (P - p_o - 2\,p_r + 2\,pr_o) \cdot dt \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Q = the cross section of the aorta; c = the velocity of the pulse wave; P = the pressure varying with the time; p_o = the diastolic pressure; p_r = the reflected pressure; pr_o = the reflected part of the diastolic pressure; s = the specific gravity of the blood. In the first approximation, p_r and pr_o, can be taken as = 0. The integral then becomes = the pressure surface during the systole.

In order to obtain the stroke volume the impulse

$$Q \int_a^s P \cdot dt \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

is required.

The work to obtain the stroke volume is:

$$\int_a^s P \cdot \frac{P \cdot Q}{c \cdot s} \cdot dt = \int_a^s \frac{P^2 \cdot Q}{c \cdot s}\, dt \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

(if the reflections can be neglected).

formulas 2, 3, and 4 show how important it is that the cross section of the aorta be determined accurately.

I. Experimental procedures

The central (art. carotis, art. subclavia) and peripheral (art. femoralis) pulse curves are recorded bloodlessly by a piezoelectric technique (described in detail by PORJÉ, 1946) or through puncture of the vessel according to TYBJAERG-HANSEN. The first method gives pressure variation curves (Figures I och II). Hence the blood pressure must be determined separately. The second method gives the absolute pressure directly.

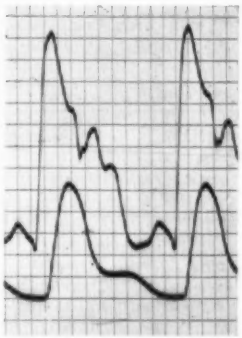


Fig. 1. Pulse curve from a healthy man, aged 21 years. The ordinata: pressure variations. The abscissa: the time graduated in 0.02 seconds. The upper curve: art. subclavia sin. The lower curve: art. iliaca sin.

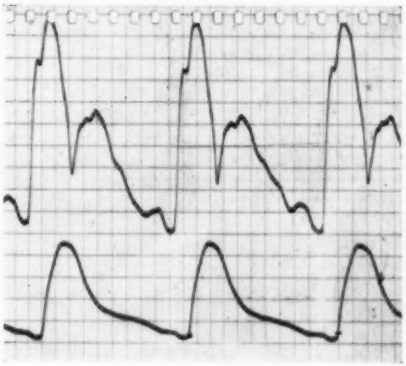


Fig. 2. Pulse curve from a healthy man, aged 37 years. The ordinata: pressure variations. The abscissa: the time graduated in 0.02 seconds. The upper curve: art. subclavia sin. The lower curve: art. iliaca sin.

II. Roentgenological Examination

The object of the examination is to ascertain (a) the cross section of the aorta and (b) its relative increase. The transverse part of the aorta (the aortic knob) is examined, since this is the only part which permits determination of the cross section. The aorta's lateral contour is clearly distinguishable in the majority of cases, while the position of the medial contour is determined by filling with barium the esophagus, which lies close beside the medial wall of the transverse part of the aorta. To obtain a successful contrast filling of the esophagus in front of the

Fig. 3 a. Fig. 3 b.

Fig. 3. Different cross sections of the aorta. The medial contour of aorta is obtained by filling the esophagus with a contrast medium (following intramuscular injection of atropine).

transverse part of the aorta, the patient must be given atropine (1 mg. intramuscularly 40 min. before the beginning of the examination) to check salivation and reduce the tonus of the esophagus and the power of contraction. Esophagus contraction would have a adverse effect on the kymographic examination, since the esophagus' own movements would also be recorded. (Fig. 3.)

The aorta's diameter between two diametrally opposite points on the lateral and medial borders of the transverse part (the latter obtained indirectly through the esophagus contrast) is measured on film (taken at 2 m. focus-film distance). Care must be taken that when the cross section is photographed, the lateral and medial contours form a *circle* (Fig. 4) and, at the same time, that the distance between the diametral points on these borders is as short as possible. The diameter of the aorta can be determined only if these conditions are fulfilled. The same precautions apply also to kymographical examination.

To obtain the outer widht of the aorta, 1 mm., representing the average thickness of the esophagus, must be subtracted from the cross

F . 4. If the aorta's cross section is not in connect projection surface obtained will be an ellipse instead of a circle.

F . 5. A mashed kymograph grid is focussed on the cross section of the aorta. The dotted lines outline the esophagus.

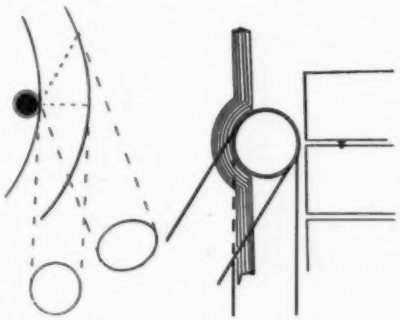


Fig. 4. Fig. 5.

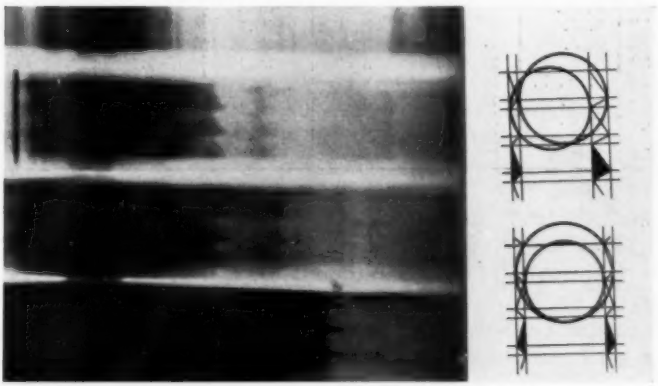


Fig. 6. Fig. 7.

Fig. 6. Kymogram on the transverse portion of the aorta (the indicated part of the kymogram). The left curve was obtained by means of the contrast filled esophagus and the right by the lateral contour of the aorta.

Fig. 7. Schematic picture of the aorta kymogram. — Above is a normal kymogram corresponding to Fig. 6. The difference in surface between the two circles (the diastolic and systolic cross section, respectively) is equal to the increase in the cross section (Δ Q).

Below is a kymogram in a case of aortic insufficiency. Large increase in cross section no lateral displacement.

se tion dimensions obtained and a further 2 mm. to obtain the aorta's in er diameter.

The relative increase in the cross section is determined kymographically with movable film — on the average the fall velocity amounts to 3 econds, but it sometimes varies upwards or downwards, depending

Table I.

Nr.	Age	Name	Blood pr	Aorta			
				Real diam.	Min. diam. measured kymographically	Diff. between max. and min. diameter	
1	60	A. A.	160/110	41.0	51.1	7.9	Aortic. insuff.
2	61	E. E.	170/0	—	48.0	4.8	— » —
3	61	N. N.	190/90	44.0	51.7	3.3	Compl. block
4	52	K. A. S.	290/170	37.0	43.8	0.4	Hypertonia
5	47	K. W.	230/140	40.0	48.0	0.7	— » —
6	62	E. E—d	230/120	40.7	49.7	0.6	— » —
7	38	A. F.	120/90	30.8	35	1.0	Normal case
8	39	A. G.	125/75	30.0	30.6	0.9	— » —
9	41	M. H.	115/85	29.2	32.2	1.1	— » —
10	52	A. J.	135/70	32.4	37.7	1.3	— » —
11	34	G. J.	155/105	32.0	36.5	1.9	— » —
12	39	N. M.	145/100	28.7	34.2	1.7	— » —
13	22	A. M. S.	125/75	23.0	28.4	1.6	— » —
14	35	B. O.	135/80	32.0	34.3	2.7	— » —
15	26	K. G.	115/65	28.1	29	1.4	— » —
16	55	G. L.	145/85	33.1	40	1.4	— » —
17	37	S. S.	130/80	27.0	30.1	1.1	— » —

on the patient's heart rythm. The heart rythm and blood pressure are measured. The patient is fastened carefully to the kymograph with a immobilisation device. Focus film distance 70 cm. (when greater distances were tried, it proved impossible to obtain sufficiently exposed pictures of the rapid movements in question.) This procedure gives some degree of enlargement, but this is of no practical importance when the object is to obtain only the relative increase in the cross section. The distance between the kymographic strips is 36 mm. During fluoroscopy a certain strip is focussed on the transverse part of the aortic arch (Fig. 5).

The principle involved in this examination is a constant registration of two diametrally located points on the aorta; in other words, the diameter of the aorta, somewhat enlarged, is registered at each instant. Thus curves are obtained which show the diameter of the aorta as a function of the time (Fig. 6). The maximal increase in the diameter of the aorta = the maximal diameter of the aorta minus its minimal diameter. This increase corresponds to the blood pressure amplitude. The smallest cross section of the aorta and the increase in the cross section corresponding to the blood pressure amplitude can then be calculated easily.

The expression $\frac{\Delta p \cdot Q}{\Delta Q} = \varkappa_k$: Here the quotient $\frac{Q}{\Delta Q}$ is independent of absolute magnitude of Q and ΔQ.

Q = the smallest cross section.

ΔQ = the increase in cross section corresponding to the blood pressure amplitude.

Δp = the blood pressure amplitude.

$\varkappa_k$ = the cross section elasticity modulus (in analogy with FRANK's elasticity modulus).

The curve obtained when the lateral contour of the aorta only is registered has very little in common with the extension curve of the aorta. In marked lateral displacements the actual amplitude may be small, and vice versa. For example, in aorta insufficiens the lateral displacement may be small, while the increase in the cross section is large. The lateral curve may, for example, correspond to half of the increase in the cross section (Fig. 7).

SUMMARY

The authors report on the principles involved in the determination of certain hemodynamic values by physical means. These may be determined with greater exactitude than hitherto with the aid of roentgen examination and roentgenkymography. The values in question are the elasticity modulus of the aorta, the stroke volume, the power and the work required to drive the stroke volume out of the heart into the aorta.

ZUSAMMENFASSUNG

Verff. berichtet über die bei der mit physikalischen Mitteln vorgenommenen Bestimmung gewisser hämodynamischer Werte zur Verwendung kommenden Prinzipien. Diese Werte lassen sich durch Röntgenuntersuchung und röntgenologische Kymographie genauer bestimmen als bisher. Die betreffenden Werte sind der Elastizitätsquotient der Aorta, das Schlagvolumen sowie die für die Austreibung des Schlagvolumens des Herzens in die Aorta erforderliche Kraft und Arbeitsleistung.

RÉSUMÉ

Les auteurs discutent les principes quir égissent la détermination par des moyens physiques de certains facteurs hémodynamiques. Ceux-ci peuvent être évalués d'une manière plus exacte qu'au paravant à l'aide de la radiographie et de la kymographie. Les facteurs en cause sont l'élasticité de l'aorte, le volume par pulsation, la force et le travail requis pour expulser ce volume du coeur dans l'aorte.

BIBLIOGRAPHY

ALÉRIA, A., Hemodynamical Studies, Acta Physiol. Scand. 1940, 16, 83.
PERJÉ, I. G., Studies of the arterial pulse wave, particulary in the aorta. Acta Physiol. Scand. 1946, suppl. 42.

FROM THE DEPARTMENT OF ROENTGENOLOGY OF THE OSLO MUNICIPAL HOSPITAL, ULLEVÅL, NORWAY (CHIEF: J. FRIMANN-DAHL, M. D.)

A CASE OF CHRONIC, NON-SPECIFIC JEJUNITIS AND STENOSIS[1]

by

O. W. Husebye

The small intestine may be the part of the digestive tract most difficult to examine roentgenologically. The localised inflammations in this part of the intestine are of a certain interest. The chronic ileitis is frequently mentioned in the literature, surgically as well as roentgenologically. On perusal of available literature, we find that CHRON and YUNICH in Annals of Surgery 1941. 113. 371 describe 17 cases of ileo-jejunitis. The following case, describing a chronic inflammation localised principally to the jejunum only, may be of some interest, therefore.

In August 1928 a patient, G. H., born November 29th 1879, was admitted into the Surgical Department of the Oslo Municipal Hospital, Ullevaal. He was operated on under the diagnosis jejunitis acuta phlegmonosa. An entero-anastomosis was performed. In October 1944 he was operated on for a hydrocele. Until then, the patient stated, he had felt in good health. In October 1945 he was readmitted to the hospital under the diagnosis of »acute abdomen?».

During the entire summer of 1945 he had suffered from pain in the abdomen, especially after eating, *i. e.* when the stomach was filled. He had burning and smarting epigastric pain. Ructus and pyrosis were present. The pain appeared directly after meals, independently of the nature of the food. He also vomited. The vomit never contained food from the previous day. The appetite was poor. The patient was constipated. Natural functions otherwise normal.

Physical examination October 25, 1945

Asthenic and tired. Temperature 37.5° C. Pulse 72. Tongue wet, clean. Respiration normal. Blood pressure 90/50.

Abdomen. Operative scar in the epigastrium. No rigidity. No tenderness. No palpable tumour. Normal conditions by exploration. Benzidine reacton in feces positive. Mucus positive. Urine: Normal findings. Ewald test meal: Well digested. Congo positive. $\frac{HCl}{TA}$ 28/46. Wassermann reaction negative. Meinicke reaction negative. The patient was sent to the roentgen Department for examination of the abdomen.

[1] Submitted for publication, Jan. 28, 1948.

Fig. 1. Survey picture of the abdomen.

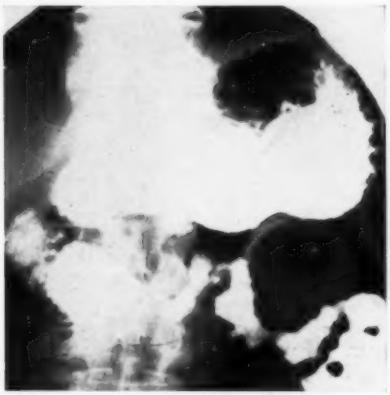


Fig. 2. Picture in supine position after an opaque meal.

Fig. 1. The survey picture in supine position shows meteorism of the stomach as well as of the colon. In the middle of the abdomen some gas-filled intestinal loops with greatly thickened walls are seen. No signs of free gas nor of free fluid in the peritoneal cavity.

Because of his poor general condition the patient could not be examined in standing position. The patient was then given an opaque meal.

Fig. 2. The upper part of the small intestine (jejunum) had a peculiar appearance. The contours were irregular with defects in the contrast together with numerous strictures. The passage of the opaque meal was delayed. Roentgenologically it was suspected to be a cancer with shrinking processes in the jejunum. At any rate, the roentgen examination proved this to be a narrowing process in the greater part of the jejunum with signs of dilatation in the duodenum and the initial part of the jejunum.

As the patient had great difficulty in retaining the food, a gastrojejunostomy was performed on November 3rd. The stomach was surrounded by adhesions. No tumour was felt in the duodenum. From the plica duodenojejunalis, almost down to the ileum, numerous dilatations

could be seen, and stenosis in the jejunum. The intestinal lumen was very narrow in some places. These changes seemed to be due essentially to the mucosa, muscularis and serosa being less affected. In one place there was marked congestion of serosa to a length of about one yard. Here the mesentery was hypertrophic with numerous enlarged glands. The previous enteroanastomosis was situated at the transition between jejunum and ileum. Due to the numerous adhesions it was considered correct to perform a gastro-jejunostomy only.

On 23rd November 1945 gastric retention was noted. There was edema of the ankles. Two weeks later an exacerbation took place and gastro-jejunostomy, jejuno-jejunostomy were then performed.

Three weeks after the operation the patient died.

Post-mortem examination

The stomach was dilated, contained $1^1/_2$ litres of thin greenish fluid Gastro-jejunostomy had been performed. In the anastomosis there was a small granular opening (fistula). Otherwise the anastomosis was healed, with passage to the afferent as well as the efferent intestinal loops. To a great extent the duodenum was dilated, but with no scarring.

The jejunum had an unusual appearance with strictured and dilated sections in the whole of its extent. Here there was an anastomosis between two intestinal loops by which a 30 cm long intestinal loop had been excluded from the jejunum. This contained several constrictions. There were also constrictions in the rest of the jejunum. The intestinal wall in the dilated parts were hypertrophic, but neither serosa nor mucosa were discoloured. In the mesentery there were numerous nut-sized, rather solid glands of greyish colour.

The spleen was small, atrophic, weighed 25 gr., smooth, shiny and with effaced markings.

Post-mortem diagnosis: Bronchopneumonia on the right side. *Gastro-enterostomy with fistula and localised peritonitis. Shrinking and scarring in the jejunum.*

Histological examination

A section from the resected jejunal loop showed the mucous membrane to be almost intact. In some places the mucous membrane was exfoliated and replaced by connective tissue, rich in cells, with numerous capillaries, fibroblasts, lymphocytes, plasma cells and a few granulocytes, of the appearance of granulated tissue. It also contained considerable collagenous fibres. The tissue extended to the muscular layer. From the muscular layer to the serosa small infiltrations were found of lympho-

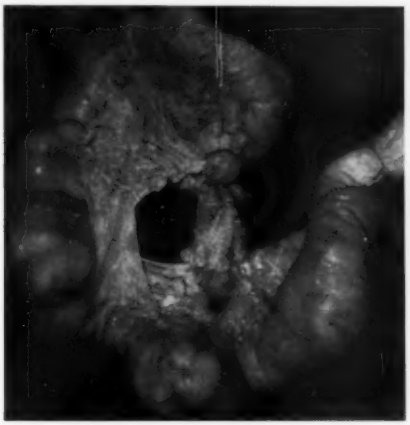


Fig. 3. Picture of the diseased jejunal loop after death.

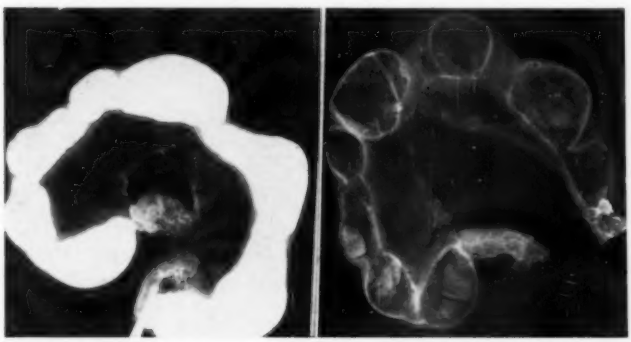


Fig. 4. Fig. 5.

Fig. 4 and 5. The same loop filled up with contrast and air respectively.

cytes and plasma cells. In the connective tissue and muscular layer the infiltrations were lying in long, narrow heaps. They were of a phlegmonous character. Submucosa was rich in vessels. The muscular layer was hypertrophic. *Diagnosis: Subacute chronic ulcerative inflammation.*

It was thus proved by post-mortem examination, that the patient had a subacute chronic, non-specific inflammation with numerous strictures in the jejunum. At the roentgenological examination there was some difficulty with regard to the exact diagnosis.

Re-examination of the pictures showed distinct and extensive hypertrophy of the jejunal wall. The examination with opaque meal (fig. 2) demonstrated numerous intestinal strictures, which are so unusual in a cancerous process.

Fig. 3 is a picture post-mortem of the pathologically altered intestine. Figs. 4 and 5 are post-mortem pictures of the same part of the jejunum filled with air and opaque meal respectively. These three pictures demonstrate the numerous shrinkings of the chronically infected jejunal loop. A resection for exclusion of this loop was performed in 1928 because of an acute phlegmonous jejunitis.

SUMMARY

The author records a case of chronic, non-specific jejunitis with numerous strictures in a patient who had been operated on in 1928 for acute phlegmonous jejunitis. The diagnosis is verified by post-mortem examination. The roentgen findings are especially mentioned.

ZUSAMMENFASSUNG

Verf. berichtet über einen Fall von chronischer, unspezifischer Jejunitis mit zahlreichen Strikturen bei einem Kranken, der im Jahre 1928 wegen akuter, phlegmonöser Jejunitis operiert worden war. Die Diagnose wurde bei der Sektion bestätigt. Die Röntgenbefunde werden besonders erwähnt.

RÉSUMÉ

L'auteur relate un cas de jéjunite chronique non spécifique accompagnée de nombreux rétrécissements chez un malade qui avait été opéré en 1928 de jéjunite aiguë phlegmoneuse. Le diagnostic est vérifié à l'autopsie. Les constatations radiologiques sont l'objet d'une mention spéciale.

REFERENCES

CHRON et YUNICH: Annals of Surgery: 113, 371, 1941.

FROM THE ROENTGEN DEPARTMENT OF THE CENTRAL HOSPITAL, BORÅS, SWEDEN
(HEAD: DR. E. HAGBERG)

PNEUMATOSIS CYSTOIDES INTESTINI[1]

(Contribution to casuistics)

by

Nils Frostberg

In March 1946 I had occasion to examine a case of pneumatosis cystoides intestini at this Roentgen Department. As both the clinical and the roentgenological findings were in agreement, the diagnosis could be established with great probability and it was verified by exploratory laparotomy undertaken later.

The case concerned a 64-year-old farmer. For 10 years in spring and autumn he has had periodically abdominal trouble occurring as a feeling of tension and pain up in the epigastrium. The trouble set in approximately 1 hour after meals and was not relieved by food. No night pains. For the last 14 days has again noticed similar trouble. Has not vomited, was not ill otherwise, visited our medical policlinic because of these complaints. *Status:* completely unaffected (temp. 36.4°, pulse normal) Abdomen: quite soft everywhere. Indicates some tenderness up in the epigastrium and around the navel. Weber in faeces neg. S.R. = 8 mm/1 hr. On *Roentgen examination* a small amount of free gas was found below both diaphragmatic arches (Fig. 1 a and b). The stomach was ptotic and to begin with it appeared that the contrast emptied through pylorus with a certain difficulty. After a while the evacuation set in well and apart from a coarse-meshed mucous membrane relief, no changes in the stomach or the pylorus region could be demonstrated. It was difficult to keep the bulb well filled, but any gross alteration here could be excluded (see operation report). Forcing out the contrast brought out no sign of perforation of the stomach or the duodenum. The jejunum and ileum transit was rather slow. The upper loops of the small intestine were rather wide and with sharp mucous membrane relief. No pathological contrast defects were seen in filled intestine loops. *A peculiar micro-alveolar structure involving a rather large area of the right abdomen appeared on one of the plates* (Fig. 2). On examination 4 hours later it seemed as though the free gas under the diaphragm arch had increased.

As the patient showed no clinical sign of peritonitis, I considered that on the basis of the Roentgen findings I was justified to adhere to the probable diagnosis pneumatosis cystoides intestini.

On *exploratory laparotomy* (MÖLLER) the same day there was found in the abdomen a moderate amount of clear light yellow fluid. No fibrine or gastric or intestinal content. The stomach was quite large and dilated but there was nothing obviously hypertrophic

[1] Submitted for publication, Febr. 13, 1948.

Fig. 1 a.

Fig. 1 b.

Fig. 2.

about the wall. There was no ulcus or infiltration in the wall. The pylorus was possibly somewhat ridged but the passage was the width of a finger. The anterior duodenal wall nearest to pylorus was diffusely thickened but no ulcus infiltrate with scar-like conversion of the serosa was found. Nor was there any perforation. The colon was quite large and gasfilled but nowhere was any definite pathological process or sign of perforation seen. On examining the small intestine there were found in several spots rather exte-

ive regions where the intestinal wall felt peculiarly pitted and granulated, due to ounded greyish formations, which lay in the wall under the serosa nearly the size of bean and spread over the intestine. They felt quite firm and were well separated from ach other, so that the intestine wall assumed a very peculiar appearance, as if it were bead necklace. Whether it was a question of gas-filled or fluid-filled space could not e definitely determined. The changes were found to extend over the greater part of the mall intestine but, between the quite extensively modified areas, there were others me dm. in length where no such formations were found but where the intestine was mewhat oedematous and loose in the wall. As it was considered the changes were used by pneumatosis intestini, no further surgical measure came into question, but the abdomen was closed after the fluid had been drawn out and the cavity drained.

The patient was discharged as free from trouble and cured.

Pneumatosis cystoides intestini has been known since 1823 in veterinary medicine. It is fairly common in swine. In human beings it is rare. Here in Sweden the disease has been the object of close investigation by NÄSLUND who considers it to be due to a particular coli-like bacterium. Isolated cases have been described by ENGLUND and WAHLGREN, GRÅBERGER, BERGLUND, STENSTRÖM and others.

RUCKENSTEINER and KUX in 1933 described a case of spontaneous pneumoperitoneum with interposed intestine between the liver and the diaphragm arch. This intestine loop displayed a peculiar spotty structure. On fresh examination 3 days later interposition was no longer found, but an intestinal loop in the lower part of the abdomen displayed similar structure and it was supposed that it was the loop previously interposed. They state that, with spontaneous pneumoperitoneum of unclear genesis, one should always think of pneumatosis cystoides intestini. In such case, efforts should be made to get at the bladder structure.

Most of the cases have not been diagnosed until operation. I have only found two in the literature where the diagnosis was established before operation. One of them is described by REVERDIN and he based his interpretation on the cyst-like intestinal structures, as in my case. In the Yearbook of Radiology 1947, there is another similar case, described by LERNER and GAZIN, but the diagnosis in this case was not verified by operation.

It is especially to point out the possibility of pneumatosis cystoides intestini as of importance in pneumoperitoneum of obscure genesis that I have related this case of mine. I wished moreover to emphasise the significance of micro-alveolar, cystic structures in the abdomen in such cases.

SUMMARY

The author communicates a case of pneumatosis cystoides intestini where the diagnosis verified at a subsequent exploratory laparotomy could be established with great probability already on the basis of the roentgen findings.

ZUSAMMENFASSUNG

Verf. teilt einen Fall von Pneumatosis cystoides intestini mit, bei dem schon a
Hand des Röntgenbildes die Diagnose, welche bei einer späteren Probelaparotomi
bestätigt wurde mit grosser Wahrscheinlichkeit gestellt werden konnte.

RÉSUMÉ

L'auteur décrit un cas de pneumatose cystoïde intestinale chez qui, déjà à l'exame
radiologique, on pouvait soupçonner ce syndrome. Une laparatomie exploratrice prat.-
quée ultérieurement a confirmé cette hypothèse.

BIBLIOGRAPHY

1. Baumann-Schenker: Über Pneumatosis cystoides ventriculi et jejuni. Acta Radiologica XX, 1939 p. 365.
2. Berglund: Roentgen Diagnosis of Pneumatosis cystoides Intestinorum Hominis. Acta Radiologica XX, 1939, p. 401.
3. Forfota: Die Pneumatosis cystoides intestini im Röntgenbilde. Fortschr. a. d. Geb. Rtg.str. 53, 1936, p. 131.
4. Englund and Wahlgren: Fall von Pneumatosis cystoides intestinorum beim Menschen. Acta chir. scand. 76, 1935, p. 601.
5. Gråberger: Beitrag zur Kenntnis des Röntgenbildes bei Pneumatosis cystoides intestinorum. Acta Radiologica XVI, 1935, p. 439.
6. Laurell: Röntgenbefunde bei akuten Erkrankungen der Bauchhöhle. Der Chirurg 1930, II, p. 422.
7. Lerner and Gazin: Pneumatosis Intestinalis: Its Roentgenologic Diagnosis. Yearbook of Radiology 1947, p. 145.
8. Ruckensteiner und Kux: Über die Pneumatosis cystoides intestini und die Möglichkeit ihrer röntgenologischen Diagnose. Fortschr. a. d. Geb. Rtg.str. 47, 1933, p. 661.
9. Stenström: Reflexionen über die Ätiologie des spontanen Pneumoperitoneums gelegentlich eines Röntgenbefundes. Acta Radiologica XVIII, 1937, p. 625.
10. Urban: Anatomische und röntgenologische Befunde bei der Pneumatosis cystoides intestini. Fortschr. a. d. Geb. Rtg.str. 55, 1937, p. 231.

FROM THE ROENTGENOLOGICAL DEPARTMENT OF THE OSLO MUNICIPAL HOSPITAL, ULLEVÅL, NORWAY (CHIEF: J. FRIMANN-DAHL, M. D.)

CASE OF BENIGN MYOMA IN THE STOMACH[1]

by

O. W. Husebye

The following concerns a patient, A. C., born 30th November 1887, who at the age of 17 had undergone an otitis media. On two previous occasions, 14 and 9 years ago, she had severe melena and was confined to bed for one year. Blood transfusions were administered. The roentgen examination showed neither ulcer nor tumour in the stomach. Ten years ago appendicectomy had been performed. In the autumn of 1942 she showed signs of thyreotoxicosis. She had staring eyes, was tired, indisposed, nervous, restless and trembling. In the course of seven months her weight had been reduced by 18 kilos.

On February 23rd 1943 she was admitted into the Medical Department of the Oslo Municipal Hospital Ullevaal, under the diagnosis thyreotoxicosis. Three to four weeks before admission the patient had suffered from dyspepsia and epigastric pain, which disappeared during meals. There were palpitations.

Physical examination February 23, 1943. Restless, nervous, protuberant eyes. Her skin was warm and soft. *Graefe positive. Stellwag positive.* Pulse 92. No edema. No exanthema.

The thyroid gland slightly enlarged. Otherwise normal findings.

Metabolic rate 138 per cent. Sedimentation rate 27. Hemoglobin 110 per cent. Ewald test meal 10 cc.: Badly digested, mucus positive, Günzburg negative. Seven examinations of the feces showed no signs of hemorrhage. The Medical Department established the diagnosis thyreotoxicosis.

Because of her dyspepsia she was brought to the Roentgen Department for examination.

The roentgen findings are most interesting, and are as follows:

The lumen of the stomach is occupied by a rather sharply defined mass filling up and stretching the stomach. It appears as if the stomach was stuffed by a sausage-like mass. The greater curvature as well as the lesser seem smooth with no signs of infiltration. The draining of the stomach takes place without difficulty. The possibility of a clot must be considered.

Roentgen diagnosis: Abnormal contents in the stomach (clot?).

A few days later a re-examination of the patient gave the same findings, which made the diagnosis clot less probable. The negative benzidine reaction also points in the same direction.

In order to arrive at a more precise diagnosis the patient was given

[1] Submitted for publication Jan. 28, 1948.

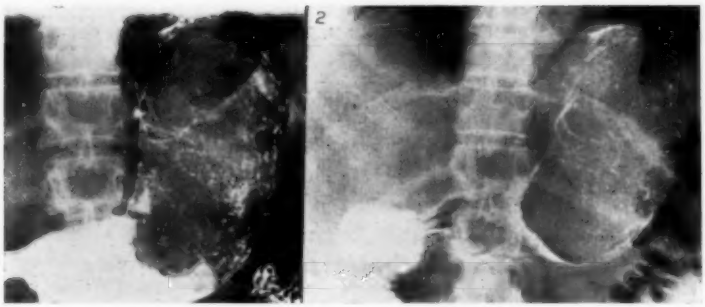


Fig. 1. Fig. 2.

Fig. 1. Roentgenpicture of the stomach in standing position.
Fig. 2. Roentgenpicture of the stomach in supine position.

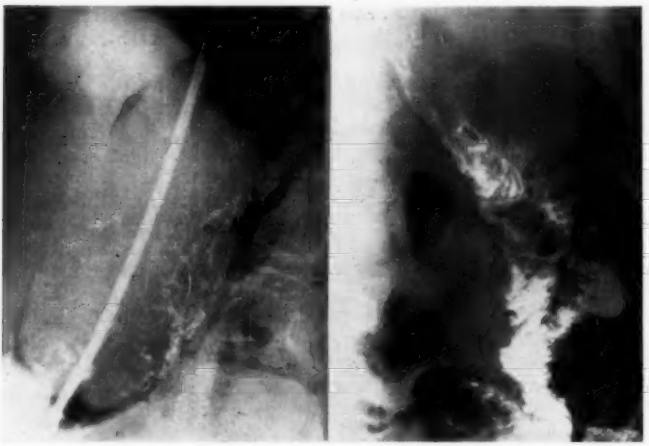


Fig. 3. Fig. 4.

Fig. 3. Roentgenpicture of the stomach in profile position and gives a good impression of the size of the tumour. The tumour measured 20 × 12 × 5 cm. Furthermore air is seen confining tumour except anteriorly where a pedicle vas found in the specimen.
Fig. 4. The conditions half a year after gastrectomy. The patient was then in good helth.

an opaque meal. Under fluoroscopy a duodenal sound was introduced very carefully into the canalis ventriculi, and with a syringe small quantities of air was blown into the stomach with the utmost care. The air ascended between the »tumour» and the stomach wall. The »tumour» surface is smooth and regular everywhere. The air formation seemed to

Fig. 5. The tumour situated in the stomach. Specimen after operation.

isolate the »tumour» from the stomach-wall leaving only a small pedicle anteriorly laterally. It was considered, therefore, to be a tumour probably deriving from the anterior stomach wall. A tumour of this size filling the corpus and the fundus ventriculi, is relatively rare. Under such circumstances a tumour of the consistency of lac must be considered. Such a tumour should be hard, however, and easily palpable. According to information from the patient trichobezoar could be excluded.

The roentgen examination gave no data in support of the diagnosis of cancer, as no infiltration in the stomach wall could be seen. A sarcoma of this size would be expected to show an ulceration.

One possibility remains now, that of a benign tumour. It may be a myoma, a myxofibrolipoma or a hemangioma.

Roentgen diagnosis: Probably benign tumour in the stomach.

Gastroscopy was then carried out without difficulty. From angulus to fornix a large tumour mass was seen, completely covered by mucous membrane.

The tumour which was distinguishable from the rest of the stomach wall by its paler colour, had some congested and bleeding parts. The tumour was sharply defined.

Gastroscopy: Benign gastric tumour.

The patient suffered from two diseases, thyreotoxicosis and gastric tumour, probably benign.

On March 23rd 1943 subtotal strumectomy was performed. The course was uneventful. After the operation the patient felt quite well. Two months later subtotal gastrectomy was performed, revealing a large tu-

mour which occupied the whole of fornix and corpus ventriculi. Sinus and canalis were free.

Specimen: The tumour is situated in the stomach and is of the same shape as the stomach. Size 20 × 7 × 5 cm. The surface is even and covered with mucous membrane. The tumour is fixed to the stomach wall by a pedicle consisting of mucous membrane. The latter is situated anteriorly on the greater curvature 5 cm from the upper edge of the operative incision. The cut surface is greyish-red, partly necrotic, with grey, cicatricial changes and calcifications. No ulceration could be observed.

The microscopical examination demonstrated an enormous hypertrophy of the muscular layer. No noteworthy infiltrations were seen.

Histological diagnosis: Hypertrophia muscularis. Myoma.

In his article in Acta Radiologia no. 138—1943 GÖSTA FORSSMAN states that benign gastric tumours are more rare than malignant ones. About half of the operated cases of benign tumours are myomas. However, he has no cases of similar size as the above-mentioned. In our case there was calcification in the tumour. This was not observed at the roentgen examination, because no survey picture was taken.

With regard to hemangiomas in the stomach several authors point out the importance of finding calcifications of the shape of phleboliths. In our case the calcifications were quite irregular, probably due to hemorrhage and necrotic processes in the myoma. Such processes are familiar in myomas.

It is of great importance to introduce the air into the stomach with the aid of a duodenal sound and a syringe, in order to obtain the most accurate roentgen diagnosis.

SUMMARY

The author describes a case of a calcified myoma in the stomach of unusual size. The diagnostic significance of air-filling the stomach is mentioned.

ZUSAMMENFASSUNG

Verf. beschreibt einen Fall von ungewöhnlich grossem, verkalktem Myom des Magens. Die diagnostische Bedeutung einer Luftfüllung des Magens wird erwähnt.

RÉSUMÉ

L'auteur décrit un cas de myome calcifié, et de grandeur peu commune, de l'estomac. Il fait mention du rôle que le remplissage avec de l'air peut jouer pour établir le diagnostic.

REFERENCES

GÖSTA FORSSMAN: Acta Radiologica. 24: 135, 1943.
GÖSTA GRÅBERGER: Acta Radiologica. 25: 504, 1944.

FROM THE ROENTGEN KAROLINSKA SJUKHUSET DIAGNOSTIC DEPARTMENT OF STOCKHOLM, SWEDEN (CHIEF: PROFESSOR ÅKE ÅKERLUND)

SOME OBSERVATIONS ON THE ROENTGEN DIAGNOSIS OF NON-OPAQUE FOREIGN BODIES ASPIRATED INTO THE BRONCHI[1]

by

Sölve Welin

The aspiration of non-opaque foreign bodies is not uncommon. Organic foreign bodies carry a greater risk of infection and abscess formation than do inorganic foreign bodies. Furthermore, a number of the former possess the capacity of swelling in the bronchial secretion. This is especially the case in vegetal foreign bodies; the diagnosis of these is therefore of the utmost importance. Notwithstanding the fact that the organic foreign bodies are »non-opaque» roentgen examination remains in these cases by far the most important procedure.

During the last 4 years 13 such cases have been met with at the Caroline Hospital. A good deal of experience hitherto not described in the literature has been gained, and a report may perhaps be considered of interest.

It has long been recognized that even non-opaque foreign bodies may be roentgen diagnosed thanks to the indirect symptoms they induce, namely valvular obstruction and atelectasis. These changes are so well known that they need no further description.

With regard to valvular obstruction, however, it should be stressed that even a fairly marked one must be assessed very guardedly. One should always bear in mind that other affections causing a local swelling of the mucous membrane may occasion a valvular obstruction. A bronchoscopy should therefore only be carried out when the history and the findings at examination definitely point to the presence of a foreign body, especially as bronchoscopy is by no means a trivial intervention — at least not in the case of young children and it is particularly they who are most frequently concerned. Indeed, bronchoscopy must be considered as a serious measure in young children.

[1] Submitted for publication, Febr. 18. 1948.

In order to increase the certainty of the roentgenological examination we have therefore on the slightest suspicion of a foreign body begun to supplement the routine chest radiographs with a series of extra-hard films in various optimal positions chosen by fluoroscopy. In examining children the tension is increased from 80 to 90 K.V. and the time prolonged from 0.03 to 0.8 sec. In examining adults the corresponding increases are from 80 K.V. and 0.05 sec., respectively, to 90 K.V. and 0.10 sec. mA 300. The LYSHOLM stationary grid is used save in the case of the youngest children.

One picture with a postero-anterior exposure is made and also two or three exposures in the oblique projection of the suspected side, with the patient placed in such a position that the larger bronchi, where feasible, are projected within the cardiac shadow, over a potential atelectatic density or, in the case of the upper lobe bronchi, within the mediastinal shadow.

Owing to the air-content of the bronchial lumen the bronchi may be studied on these radiograms and an »air-bronchogram» thus obtained, as LINDBLOM in 1938 pointed out in a discussion on the diagnosis of pulmonary tumors at a meeting of the Swedish tuberculosis specialists at Sabbatsberg Hospital. The foreign bodies will sometimes appear as a positive shadow against the air-column of the bronchi and will sometimes occasion a more or less characteristic interruption of the bronchial lumen. Thus, not only a positive diagnosis is obtained but also a more exact localization of the foreign bodies.

It appears from table 1 that in 7 out of the 13 cases it has now been possible to demonstrate the foreign body directly. In 6 of these cases we have had to deal with organic bodies without the property of swelling. In the 7th case the foreign body consisted of resin crystals. These foreign bodies had not occasioned any complete occlusion of the bronchial lumen and in these 7 cases there was thus only valvular obstruction and no atelectasis. The foreign body had in one instance (Case 10) lain in the left main bronchus for as long as 6 weeks.

Valvular obstruction has usually been very marked as appears from fig. 1 b and 2, and in both cases it was immediately evident in which area of the bronchial tree the foreign body was to be sought. In the remainder of the cases this has been more difficult to establish.

As appears from fig. 1 c the positive shadow stands out very prominently against the air column of the bronchus and in the 6 other cases the picture has been equally convincing. All these foreign bodies were located in the main bronchi. After a direct roentgenological demonstration of foreign bodies the indication for a bronchoscopy becomes absolute. In other cases these indications may be rather relative. This, *e. g.* is the case if a roentgen examination has established a not marked but never-

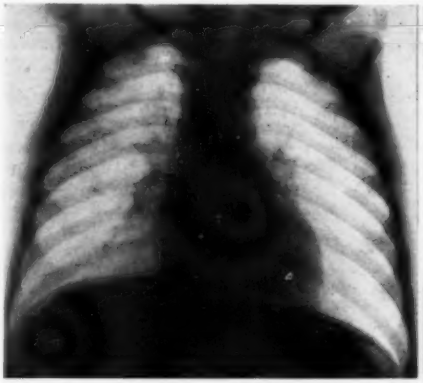


Fig. 1 a.

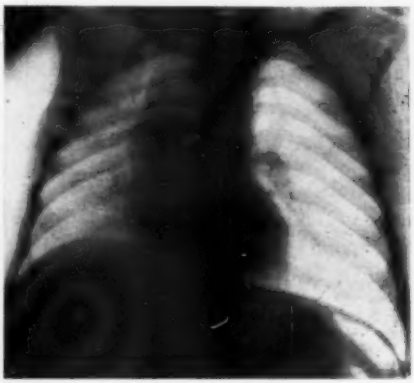


Fig. 1 b.

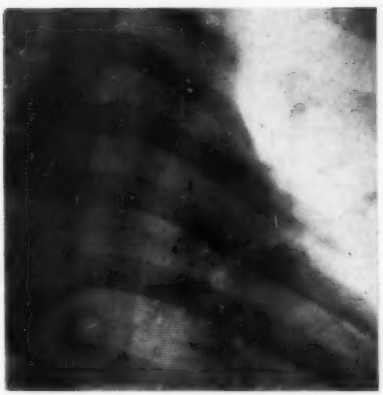


Fig. 1 c.

Fig. 1. a. Case 11. 2 year old girl with a nut-kernel in the left main bronchus. Nothing pathological seen on roentgenogram on inspiration.
b. Same case on expiration. Pronounced mediastinal shift.
c. Same case, oblique projection. Arrows point at nut-kernel.

theless unmistakable valvular obstruction and in spite of technically satisfactory extra-hard radiograms, it is not possible to demonstrate any foreign body between the carina and the branching of the main bronchus. If on lateral projections, at various stages of respiration, it has not been possible to establish a different air-content in the different lobes of the ung, one must raise the question as to whether there may be a presence of multiple foreign bodies further peripherally, or whether there exists merely a swelling of the mucosa which, for instance, may be caused by a foreign body that, at the time of examination, has already been expectorated, whithout the patient or his surroundings having observed

Fig. 2.

Fig. 2. Case 8. Check-valve mechanica emphysema of the right middl and lower lobes.

Fig. 3. Case 7. In the left main bronchu the rounded shadow of a pea, nea the carina More distally sharp cut off of the bronchus due to a secon foreign body.

Fig. 4. Case 1. The main bronchus show an interruption with convexity upwards.

Fig. 3.

Fig. 4.

the expectoration. It is therefore not possible to draw up any general rules, but the indications must be carefully weighed in each individual case.

The following case will be presented as an example.

The case is that of an 18-month-old boy (Jr. 2717/47) who on putting a coffee-bean into his mouth had a very severe attack of coughing. He subsequently had a hacking cough and after consultation at the local hospital, at which a roentgen examination of the chest was considered to show normal conditions, the patient was referred to the E. N. T. clinic of the Caroline Hospital. At a renewed roentgen examination here — 7 hours after the accident — a definite inspiratory shift of the mediastinum to the right was observed at screening, and the impression received was that a foreign body was present in the right main bronchus. In spite of a number of extra hard radiograms, however, no such body was established. The history, so suggestive of a foreign body, and the roentgenological establishment of a valvular obstruction was, on the other hand, considered to indicate a bronchoscopy. At this, only a reddened trach

Table 1

		Foreign body	Direct visualization on roentgen	Bronchial occlus.	Atelectasis	Valvular obstruction	Time between accident and roentgen diag.
1	♂ 1 yr. 915/43	pea	+	+	Total	—	72 hr.
2	♂ 1½ yr. 239/46	almond	+	—	—	+	24 hr.
3	♂ 3 yr. 1762/46	pea	—	+	+	—	4 wks.
4	♀ 2 yr. 2057/46	pea	—	+	+	—	120 hr.
5	♀ 1½ yr. 2238/46	ear of wheat	—	+	+	—	2 mo.
6	♀ 40 yr. 2474/46	pear	+	—	—	+	7 hr.
7	♀ 1½ yr. 2803/46	2 peas	+	—	Total	—	24 hr.
8	♂ 1 yr. 116/47	nut-kernel	+	—	—	+	1 mo.
9	♀ 2 yr. 410/47	turnip	+	—	—	+	96 hr.
10	♀ 1½ yr. 1439/46	bit of gristle	+	—	—	+	6 wks.
11	♀ 2 yr. 492/47	nut-kernel	+	—	—	+	12 days
12	♂ 7 yr. 1570/45	ear of wheat	—	+	+	—	216 hr.
13	♀ 2½ yr. 87/48	resin	+	—	—	+	216 hr.

and a markedly swollen mucosa on the right from the carina and down to the orifice of the bronchus of the middle lobe were found. No foreign body was observed, although it was possible to inspect all the way down to the lower lobe bronchus.

Subsequent to the bronchoscopy the patient had considerable discomfort from laryngeal stenosis, which only regressed after treatment with steam tent, calcium injections, etc.

Another detail, of great practical importance, is, in the event of a positive diagnosis, the consideration of the possibility of *more than one* foreign body. In these series there were thus in one case two peas, and such a possibility should be made clear prior to the attempted bronchoscopic removal. This is illustrated by Case 7.

An 18-month-old girl, while playing with peas, had an attack of asphyxiation which soon receded. She then seemed to be perfectly well, but was as a measure of precaution taken to the nearest hospital for examination. At admission a roentgen examination of the lungs (a radiogram on inspiration only was taken) showed entirely normal conditions, but 20 hours later, when the patient suddenly became very ill and markedly cyanotic, a massive density over the right lung was observed at a renewed roentgen examination. The child was therefore referred to the Caroline Hospital. On admission here we found on the extra-hard pictures, a shadow the size of a yellow pea located in the upper portion of the right main bronchus, and also, approximately 1 cm. distal to this, a sudden interruption of the air column of the main bronchus. (Fig. 3.)

On bronchoscopy a swollen pea was found which blocked the entire right main bronchus, displaced the carina to the left, and partially compressed the left main

bronchus. As the pea was larger than the lumen of the bronchosope (4 mm) it had to be divided prior to extraction, and then removed in two halves. Not until this was done could the pea localized further distally be extracted.

Had the clinicians not received prior information of the presence of multiple foreign bodies they would have removed the bronchoscope when the first pea was found and it would, in all probability, have been necessary to introduce the bronchoscope again, a procedure which, at least in the case of this very ill child, would have carried a considerable risk.

In the remaining 5 cases the roentgenological picture has been quite different. In these cases atelectasis was more or less marked. In Case 1 this involved the entire left lung. In the remainder of the cases the atelectasis involved a lobe or only a section of a lobe.

In all of these 5 cases we have, especially on the extra-hard roentgenograms, been able to demonstrate a very distinct interruption of the air column of the bronchus involved. In one instance — Case 1 — the occlusion of the bronchus had the form of an upwardly convex surface, as shown by fig. 4 and here the configuration was such that it gave the immediate impression that one had to deal with a pea. In the other cases the air column was interrupted sharply in a straight line and thus did not per se suggest the presence of a foreign body. In these cases we have to consider other causes, such as mucous plugs or bronchial tumors. The history and the age of the patient, however, as a rule exclude the suspicion of a tumor. In our material the finding of mucous plugs causing bronchial occlusion has been so rare that they practically do not have to be taken into consideration. One may, therefore, in the case of such an occlusion, be justified in thinking first of a foreign body, especially if it is possible to establish the interruption of the air column, described above, from the very onset of the disease. Case 5 of the present series illustrates this.

This 18-month-old patient had two months previously been referred to a local hospital with the suspicion of a foreign body in the bronchial tree. After a roentgen examination the day after the accident the diagnosis of pneumonia was made and the patient was in two succesive periods treated for two months at the hospital with a diagnosis »bronchopneumonia acuta dx.». The patient was then referred to the Caroline Hospital for further investigation. On admission here the roentgen examination showed an interruption of the air column of the right main bronchus approximately at the orifice of the middle lobe bronchus. Distal to this there was a diffuse density which on the lateral roentgen was seen to belong to the middle lobe. The density was now fairly voluminous and was perhaps mainly due to infective consolidation and not only to atelectasis. On re-examination of a number of earlier radiograms, the first of which were taken the day after the suspected aspiration, it was observed that the bronchial occlusion had remained unchanged from the start, despite the fact that the changes in the middle lobe had varied considerably. On the basis of this the diagnosis of a foreign body in the right main bronchus at the orifice of the middle lobe bronchus was made, this diagnosis being verified at bronchoscopy; the foreign body was an ear of wheat — in the distal section of the right main bronchus.

With this new method of examination it has thus been possible to make a considerably more certain diagnosis than previously, when, in cases with translucent foreign bodies, one had to content oneself with the indirect symptoms of valvular obstruction and atelectasis. We have also endeavoured to use tomography in these cases but — at least with the equipment which has been available to us — we find exposure-time too long and we have not obtained useful results in young children.

SUMMARY

In the case of translucent foreign bodies in the bronchial tree it is of the greatest importance to supplement the routine chest examination with a series of extra-hard radiograms taken under fluoroscopic control in the optimal position. In this manner it is possible in cases with valvular obstruction to demonstrate the foreign body directly. In cases which progress with atelectasis the diagnosis may be further substantiated by the demonstration of a distinct interruption of the air column of the bronchus involved. In addition to obtaining an exact anatomical localization, a potential multiplicity may also be established by this method.

ZUSAMMENFASSUNG

Bei röntgendurchsichtigen Fremdkörpern im Bronchialbaum ist es äusserst wichtig, die gewöhnliche Routineuntersuchung der Lungen mit einigen stark durchexponierten Röntgenbildern zu vervollständigen. In dieser Weise lässt sich nämlich bei Fällen von Ventilstenose der Fremdkörper direkt nachweisen und bei mit Atelektase einhergehenden Fällen die Diagnose durch den Nachweis einer distinkten Unterbrechung der Luftsäule des betreffenden Bronchus weiter bestätigen. Mit dieser neuen Methodik erzielt man nicht nur eine exakte anatomische Lokalisierung — es ist auch wichtig, eine eventuelle Multiplizität feststellen zu können.

RÉSUMÉ

Lorsqu'il s'agit de corps étrangers transparents dans l'arbre bronchique il est de la plus grande importance de compléter l'examen habituel de série des poumons par la prise de quelques radiographies faites avec des rayons durs bien pénétrants. En effet, on peut de cette façon mettre directement en évidence le cours étranger dans les cas de sténose bronchique, et dans ceux qui s'accompagnent d'atélectase augmenter la certitude du diagnostic en rendant visible une nette solution de continuité dans le cordon aérique de la bronche en question. Outre que par cette nouvelle méthode on obtient une localisation exacte on en retire encore l'avantage important de pouvoir constater la présence éventuelle de corps étrangers multiples.

LITERATURE

LINDBLOM, K.: Röntgendiagnos av lungtumör med hänsyn till symptomen vid bronkografi med luft. Nordisk Medicin 1939: 2: 1245.

FROM THE I. ROENTGENDIAGNOSTIC DEPARTMENT OF SÖDERSJUKHUSET, STOCKHOLM (CHIEF: DOCENT G. JÖNSSON), IN COÖPERATION WITH THE II. MEDICAL CLINIC OF SÖDERSJUKHUSET, STOCKHOLM (CHIEF: PROFESSOR G. NYLIN) AND THE SURGICAL CLINIC OF SABBATSBERG'S HOSPITAL, STOCKHOLM, SWEDEN (CHIEF: PROFESSOR CL. CRAFOORD)

VISUALIZATION OF THE CORONARY ARTERIES[1]

Preliminary Report

by

Gunnar Jönsson

During our investigations of the thoracic aorta with the method recently described by RADNER, BRODÉN, HANSSON and KARNELL, we succeeded in five cases in filling one or both coronary arteries with contrast medium. DEL CAMPO and HOYOS achieved the same results in 1946 by injecting contrast medium with a needle inserted directly into the aorta ascendens through the anterior thoracic wall. RADNER tried the same method in 1945 but abandoned it because of the severe accidents it often incurred. DEL CAMPO and HOYOS also mentioned that it led to pneumothorax in one case. Apparently, therefore, the method is too dangerous for routine examination. Our procedure done in connection with thoracic aortography, on the other hand, is quite harmless. In order to get the opaque substance out into the coronary arteries, the injection must be done with the catheter inserted far down in the aorta ascendens, preferably with the tip down by the semilunar valves. It lay thus far down in four of our cases, in the fifth a few centimeters higher up. We got a dense contrast shadow of the aortic bulb in all five cases. The three semilunar valves and the sinus of Valsalva show up distinctly in

[1] Submitted for publication, April 3, 1948.

the films. We have not made a close study of the roentgenographic anatomy of the coronary arteries and the technic used is still imperfect and capable of improvement in many respects. All our examinations were done in order to study the great vessels and their branches in the upper part of the thorax and the pictures were taken accordingly. The aim of this report is only to show that we now have a harmless method by which to study the coronary arteries roentgenographically.

The heart showed no reaction and the electrocardiogram had the same appearance before and after the examination.

Case 1. Female, 27 years old. Patent ductus arteriosus. The sinus of Valsalva and semilunar valves are clearly seen. The two coronary arteries are also visible.

Case 2. Male, 46 years old. Patent ductus arteriosus. The right coronary artery and part of its branches are visible.

Fig. 3 a. Antero-posterior view.

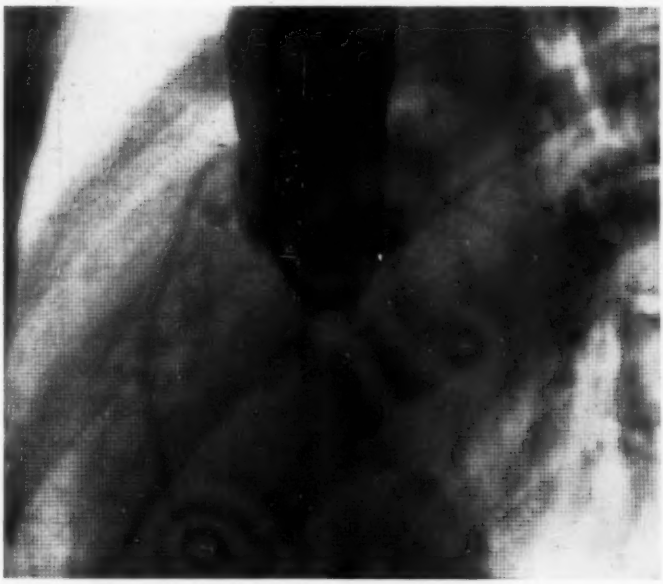


Fig. 3 b. Lateral view.

Case 3. Female, 22 years old. Patent ductus arteriosus. The aortic bulb and the two coronary arteries are visible.

SUMMARY

The author shows the possibility of visualizing the coronary arteries by the method used in thoracic aortography described by BRODÉN-HANSSON-KARNELL.

ZUSAMMENFASSUNG

Verf. beschreibt die Möglichkeiten zur Sichtbarmachung der Koronararterien mit der von BRODÉN-HANSSON-KARNELL beschriebenen Methode zur Aortographie der Brustaorta.

RÉSUMÉ

L'auteur montre qu'il est possible de rendre visibles les artères coronaires par la méthode utilisée en aortographie thoracique et décrite par BRODÉN-HANSSON-KARNELL.

REFERENCES

DEL CAMPO, C. G. and HOYOS, J. M.: Angiography of the thoracic aorta and coronary vessels. — Radiology. 50: 211. 1948.

RADNER, S.: An attempt at the roentgenologic visualization of coronary blood vessels in man. — Acta radiol. 26: 497. 1945.

—, Thoracal aortography by catheterization from the radial artery. — Acta radiol. 29: 178. 1948.

BRODÉN, B., HANSSON, H. E. and KARNELL, J.: Thoracic aortography. — Acta radiol. 29: 181. 1948.

FROM THE MEDICAL AND ROENTGENOLOGICAL DEPARTMENTS OF THE CHILDREN'S HOSPITAL, GOTHENBURG, SWEDEN (CHIEF OF THE ROENTGENOLOGICAL DEPARTMENT: DR. C. J. HANSSON) AND THE PEDIATRIC CLINIC OF KAROLINSKA INSTITUTET AT NORRTULL'S HOSPITAL, STOCKHOLM, SWEDEN (CHIEF: PROF. A. WALLGREN)

THE VALUE OF ROENTGENOGRAPHY IN THE DIAGNOSING OF CARDIAC DISORDER FOLLOWING RHEUMATIC FEVER[1]

by

C. J. Hansson and *Erik Jacobsson*

During recent years, roentgenography has become of increasing importance as an aid in diagnosing and establishing the prognosis with regard to valvular disease of the heart. It is now not often that a diagnosis of valvular defect is established without an attempt having first been made to study its nature and severity by means of a roentgen examination; at least in all large towns where a trained roentgenologist is available this principle is largely applied. It is now possible, thanks to the investigations of LILJESTRAND, LYSHOLM, NYLIN and ZACHRISSON, to form an idea of the size of the heart in relation to what is generally considered to be normal, and this circumstance, in Sweden especially, is undoubtedly of great value for an estimation of the conditions in valvular and other types of cardiac disease.

During the years 1944—45, all patients treated for rheumatic fever, or any of the other conditions commonly falling under this designation, at the Gothenburg Children's Hospital during the period 1922—1940 were submitted to a follow-up examination with a view to gaining some idea of the prognosis in this disease as judged on the basis of a uniform Swedish series. For natural reasons this investigation largely took the form of an examination of the condition of the heart in these patients, and was concerned to a large extent with the conclusions to be drawn from it regarding the prognosis in rheumatic fever. The clinical examinations in this investigation were carried out by JACOBSSON and the roentgenologic work was done by HANSSON. Before the examination, each patient had been sent a questionnaire containing various questions,

[1] Submitted for publication, Febr. 13, 1948.

among which there were also some regarding heart symptoms in the personal history. At the subsequent clinical examination the answers to these questions were controlled and studied in more detail. The findings were then used as a background when the subsequent evaluation of the patient's heart was being made.

The heart of each patient was submitted to a thorough physical examination, both under resting conditions and after exertion, and an electrocardiogram was also made in each case. Roentgen examination of the heart was then carried out.

The only information given to the roentgenologist was that the patient in question had had a rheumatic infection, and he was therefore not influenced during his studies by any findings that might have been made at the physical examination. During the course of the investigation clinician and roentgenologist then met for discussions regarding each individual case, comparing one another's findings and on the basis of the results classifying the patients into different groups. In order to check up as far as possible on the effectiveness of this grouping system the material was then studied once again, this time from the aspect of the roentgen findings alone without any consideration being paid to clinical findings; it was found that the grouping carried out in the first instance had been retained almost in its entirety, only one or two isolated cases diverging from the original classification.

The roentgen examinations and measuring work were done in every instance in accordance with the method worked out by NYLIN and LYSHOLM on the basis of Karlsdorf's theories. The focal film distance was 1.5 m. Owing to a lack of certain technical equipment antero-posterior and lateral views could not be taken simultaneously but had to be made in two different exposures. The source of error with respect to the volume determinations arising as a consequence of this is so small, however, that it does not distort the result. The volume of the heart was calculated by the formula worked out by NYLIN and LYSHOLM, *i. e.* long diameter by transverse diameter by depth by 0.42 equals the total volume. This total volume was then reduced down to a volume per square meter of body surface area (Du Bois' formula, 1927). As regards the heart volume per square meter of body surface area, the values used at Swedish hospitals as the normal upper limits — not exceeding 450—500 cc. for males (according to LILJESTRAND, LYSHOLM, et al.) and 420—450 cc. for females — were employed.

In the examination of the heart from the roentgenologic standpoint the volume alone was naturally not used as the only decisive factor; the shape also was carefully analyzed.

In all, 494 patients were examined in this manner. When subsequently studying the material from both the clinical and roentgenologi

standpoints, as described above, we endeavoured to form an idea of the agreement existing between the clinical and the roentgenologic findings and of the extent to which the roentgenogram was capable of contributing to a sure diagnosis. The material was grouped in accordance with the accompanying table (table 1).

Table 1

Heart findings from the clinical and the roentgenologic examinations

	Clinically	Roentgenologically	Number of cases
A.	sure vitium cordis	sure vitium cordis	121
B.	no » »	» » »	5
C.	sure » »	no » »	150
D.	no » »	» » »	116
E.	uncertain vitium cordis	indications of vitium cordis	42
F.	» » »	no » » » »	60
			494

As will be seen from the table, there was complete agreement between the clinical and roentgenographic findings in groups A, D, and F, or in 297 cases (60.1 per cent). There was no agreement in groups B, C, and E (a total of 170 cases, 39.9 per cent). Group B, comprising 5 cases, presents features of particular interest. In all these patients, the roentgen examination revealed clear evidence of abnormality whereas neither the clinical examination nor the personal statements as to possible heart symptoms had given any cause to suspect that organic disease was present. In a couple of the cases the clinical examination had yielded an extremely slight, weak, soft, systolic murmur that did not alter an exertion and could not be interpreted as an organic murmur. In one case displaying a configuration obviously indicative of mitral disease but without definitely established cardiac enlargement in the roentgenogram there was possibly a slightly accentuated first sound at the apex, but this did not alter after exertion and clinically could hardly give rise to the suspicion that a mitral defect might be present. The other four patients only had roentgenologic enlargement of the heart but no physical signs of cardiac disorder. Not even the electrocardiographic examination provided any signs of heart disease. A renewed examination of these five patients after the roentgen findings were known still yielded no clinical features likely to indicate the presence of organic involvement.

It is also of interest to note that in no less than 150 cases the clinical examination revealed unequivocal evidence of the fact that the patient had organic heart disease whereas the roentgen examination brought out nothing in this respect. It is possible, and even very probable, that many of these patients will also, in time, display roentgenologic evidence of heart disease. It should, perhaps, be mentioned here that the length

of the observation period, from the recovery from rheumatic fever to the time of the follow-up examination, was in no case less than 4 years. The average observation time for all cases was 12.2 years.

In order to supply an answer to the second question, *viz.* to what extent the roentgen examination had contributed towards a sure diagnosis, another table was worked up (table 2).

Table 2

Significance of the roentgenogram

		Number of cases
A.	None	121
B.	Decisive	5
C.	None	150
D.	None	116
E.	Decisive +	42
F.	Decisive —	60

In groups A, C, and D (387 cases, 78.3 per cent), the roentgen examination was of no particular significance in the diagnosing of vitium cordis, seeing that the organic involvement could be established beyond all doubt at the purely physical examination. In the remaining cases (groups B, E, and F, 107 cases, 21.7 per cent), the roentgenogram was the decisive factor for the diagnosis.

It is evident that the roentgen examination constitutes a directly positive and important aid in the diagnosing of cardiac disease, since this form of examination made it possible for us to establish the correct diagnosis in about one-fifth of the material. In those cases where the physical findings were of an uncertain nature and where roentgenography did not provide evidence of organic disease it naturally cannot be said beyond all doubt that vitium cordis is not present; the subsequent course will no doubt prove to be the decisive factor in these patients.

SUMMARY

In the years 1944—45 the authors have made a follow-up of 494 cases, who in the years 1922—1940 as children passed through one or more attacks of rheumatic fever. In connection with the cardiac examinations an attempt was made to show what part the roentgenologic examination played in the diagnosis of cardiac disorder. It was found that in 21.7 per cent of all cases the roentgenologic examination was of deciding importance for the diagnosis.

ZUSAMMENFASSUNG

Verf. hat 1944—45 eine Nachuntersuchung vorgenommen an 494 Fällen, die in den Jahren 1922—40 in ihrer Kindheit einen oder mehrere Anfälle von akutem Gelenkrheumatismus durchgemacht hatten. Gelegentlich der hierbei vorgenommenen Unte-

suchungen des Zustandes des Herzens versuchte man die Rolle der Röntgenuntersuchung für das Stellen der Diagnose eines evtl. vorliegenden Herzfehlers festzustellen. Es stellte sich heraus, dass die Röntgenuntersuchung bei 21.7 % sämtlicher Fälle für die Diagnose von massgebender Bedeutung gewesen war.

RÉSUMÉ

De 1944 à 1945 les auteurs ont réexaminé 494 sujets qui entre 1922 et 1940, pendant leur enfance, avaient subi une ou plusieurs attaques de rhumatisme fébrile. En même temps qu'on faisait à cette occasion des recherches sur l'état du cœur on a essayé de préciser le rôle que l'examen radiologique a joué pour diagnostiquer un vice cardiaque éventuel. Il a été constaté que dans 21.7 % de tous ces cas l'examen aux Rayons Roentgen avait été d'une importance décisive pour établir le diagnostic.

REFERENCES

JACOBSSON, E. G.: Rheumatic fever with chorea minor. Acta Ped. Vol. XXXIII, suppl. VII, 1946.

LILJESTRAND, G., LYSHOLM, E., NYLIN, G. and ZACHRISSON, C. G.: Normal heart volume in man. Am. Heart. J. 17: 406, 1939.

FROM THE ROENTGEN DIAGNOSTIC DEPARTMENT OF KAROLINSKA SJUKHUSET, STOCKHOLM, SWEDEN (CHIEF: PROFESSOR ÅKE ÅKERLUND)

THE ROENTGEN EXAMINATION OF THE LINGUAL TONSIL[1]

by

Sölve Welin

As a result of anatomical investigations of which the most detailed are those of TURTUR and SIMANOWSKY, we know that the lingual tonsil is scattered over the pharyngeal part of the tongue. It consists of a very fine fibrous network containing lymphoid tissue. It appears on the surface of the pharyngeal part of the tongue as a number of nodular umbilicated elevations provided with little crypts into which mucous glands open.

The lingual tonsil is subject to the same affections as the pharyngeal tonsils and can be the site of inflammatory processes without involvement of the other lymphoid tissue in the pharynx. The process can affect the whole of the tonsil or — as is more usually the case — only half of it. In some cases only a few follicles may be affected.

The tonsil can be involved by acute infectious processes, but more commonly by chronic inflammation and hypertrophy. Some authors report such hypertrophy in about 25 % of the cases with chronic hypertrophy of the other tonsils.

Enlargement of the lingual tonsil is also met with in cases of chronic lymphatic leucemia and a primary malignant tumor of the tonsil has also been described.

The patients complain of a constriction in the throat, have the feeling of a foreign body being present and have difficulty in swallowing. Laryngologists consider that the hypertrophy impairs the movement of the epiglottis.

Since enlargement of the lingual tonsil may produce diagnostic difficulties for the unaware clinician — although it is no problem to the specialist — and as the radiograph is rather characteristic in most cases, this short paper may be justified.

[1] Submitted for publication, Febr. 13, 1948.

Fig. 1. Typical defect due to lingual tonsil at the bottom of the right vallecula.

Fig. 2. Characteristic rounded shadow projecting backwards from the base of the tongue.

On the postero-anterior radiograph small enlargements can be appreciated as defects in the contrast medium at the bottom of the vallecula and in the lateral view we see them as small polypoid tumors between the base of the tongue and the epiglottis. (Fig. 1.)

In the case of larger lingual tonsils the plain lateral film shows a rounded shadow projecting backwards from the base of the tongue (Fig. 2). Using contrast medium in both the postero-anterior and lateral projections a lobulated surface is seen on the affected tonsil. (Figs. 3, 4 and 5).

In the differential diagnosis a lingual goiter must be considered. This is the least frequent of all the aberrant positions of the thyroid gland. A maglignant tumor is also a possibility. In a lingual goiter the usual picture is that of a smooth rounded mass in the preepiglottic region with relatively large blood vessels transversing its surface. According to SCHINZ there is some-

Fig. 3. The same case with contrast medium.

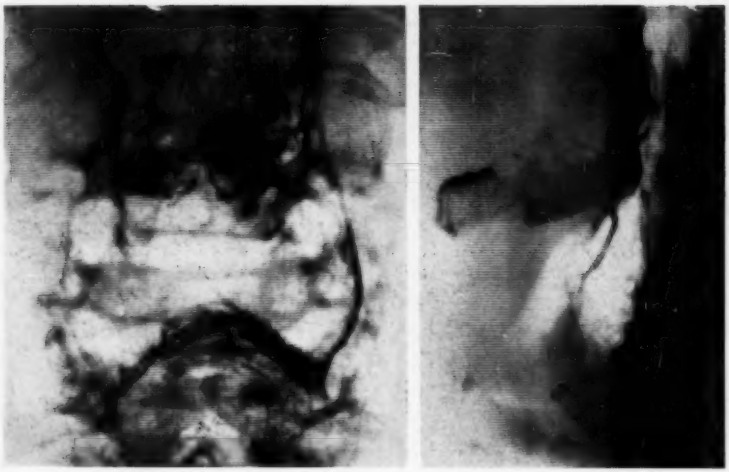


Fig. 4 and 5. Another case with an enlarged lingual tonsil in both postero-anterior and lateral projections.

times on the radiograph a calcified opacity within the pathological soft tissue shadow. The surface of the shadow is usually smooth but certain observers have described it as nodular; this would be in keeping with the usual changes found in a nodular type of goiter. In addition to this the hyoid bone is sometimes displaced distally. Occasionally the thyroid gland is not present in its normal place and in such cases removal of a lingual thyroid would result in myxedema.

In cases of malignancy in this region it has been our experience that the surface of the rounded shadow is not so smooth and there has been more irregularity of the mucous membrane. Biopsy, however, is carried out in all cases in order to confirm the diagnosis.

SUMMARY

The author describes the roentgen appearances of the lingual tonsil.

ZUSAMMENFASSUNG

Verf. beschreibt das Röntgenbild der Zungenmandel.

RÉSUMÉ

L'auteur décrit les aspects radiologiques de l'amygdale linguale.